US008509186B2

(12) **United States Patent**
Oerton et al.

(10) **Patent No.: US 8,509,186 B2**
(45) **Date of Patent: Aug. 13, 2013**

(54) **CONVERSION OF MOBILE DEVICE TO LAN-ONLY TELEPHONY FUNCTIONS**

(75) Inventors: **Kevin John Oerton**, Waterloo (CA); **Brian Alexander Oliver**, Fergus (CA)

(73) Assignee: **Research In Motion Limited**, Waterloo (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 331 days.

(21) Appl. No.: **12/843,525**

(22) Filed: **Jul. 26, 2010**

(65) **Prior Publication Data**

US 2011/0261792 A1 Oct. 27, 2011

Related U.S. Application Data

(60) Provisional application No. 61/328,097, filed on Apr. 26, 2010.

(51) **Int. Cl.**

H04W 4/00	(2009.01)
H04W 36/00	(2009.01)
G06F 3/00	(2006.01)
G06F 3/14	(2006.01)
H04W 36/16	(2009.01)
H04W 84/04	(2009.01)
H04W 84/10	(2009.01)
H04W 36/24	(2009.01)
G06F 3/0481	(2013.01)

(52) **U.S. Cl.**

CPC ***H04W 36/16*** (2013.01); *H04W 84/04* (2013.01); *H04W 84/10* (2013.01); *H04W 36/24* (2013.01); *G06F 3/04817* (2013.01)

USPC **370/331**; 370/328; 370/338; 455/436; 455/443; 455/444; 715/700; 715/864

(58) **Field of Classification Search**

USPC 370/328, 329, 331, 335, 338, 342–344; 455/436, 443, 444; 715/700, 864

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,606,190 B2 * 10/2009 Markovic et al. 370/328
2002/0132638 A1 9/2002 Plahte et al.

(Continued)

FOREIGN PATENT DOCUMENTS

EP 2018014 A1 1/2009
WO 2008058360 A1 5/2008

OTHER PUBLICATIONS

Apple: "iPhone 3G user manual", Jul. 11, 2008, pp. 1-154, XP007907619, retrieved from the Internet (http://manuals.info.apple.com/en_US/iPhone_User_Guide.pdf).

(Continued)

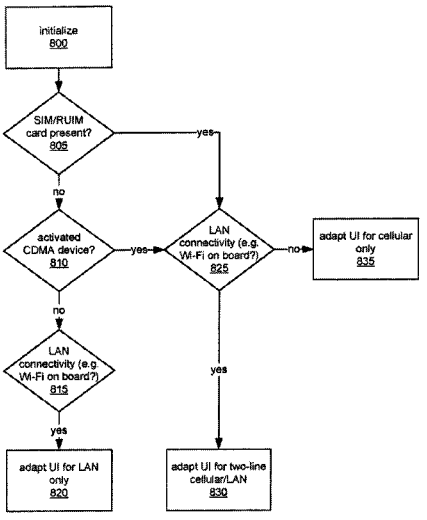
Primary Examiner — Paul H Masur

(74) *Attorney, Agent, or Firm* — Jenna L. Wilson; Dimock Stratton LLP

(57) **ABSTRACT**

A system and method implemented at a communication device for providing access to telephony services over one or more of a number of communication networks, including cellular networks and IP-based fixed and wireless networks. A mobile device may be configurable for voice communication over both a cellular network and a LAN (e.g. a wireless LAN), and may be adapted to place and receive calls via a PBX over one of the cellular network and the LAN. When it is determined that the mobile device is configured for voice communication using one or both of the cellular network connection and the LAN connection, the mobile device may automatically adapt its user interface to reflect the availability of voice communication only over those connections that are available.

17 Claims, 10 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2004/0087307	A1*	5/2004	Ibe et al.	455/436
2004/0266426	A1*	12/2004	Marsh et al.	455/426.2
2005/0170854	A1	8/2005	Benco et al.	
2005/0190747	A1*	9/2005	Sindhwani et al.	370/352
2006/0121916	A1	6/2006	Aborn et al.	
2006/0159109	A1*	7/2006	Lamkin et al.	370/401
2007/0129103	A1	6/2007	Al-Shaikh	
2007/0206569	A1	9/2007	Silver et al.	
2007/0206580	A1	9/2007	Silver et al.	
2007/0268858	A1*	11/2007	Soto	370/328
2007/0281682	A1	12/2007	Raju et al.	
2008/0113683	A1*	5/2008	Paas et al.	455/552.1
2008/0130554	A1	6/2008	Gisby et al.	
2009/0113460	A1	4/2009	Parrish et al.	
2009/0258668	A1	10/2009	Kumar et al.	
2009/0279683	A1	11/2009	Gisby et al.	
2010/0009674	A1	1/2010	Sapkota et al.	

OTHER PUBLICATIONS

Private Mobile Networks Ltd, "Fixed Mobile Integration: Realising the potential of Private GSM Networks", White Paper, 2006, retrieved from http://www.teleware.com/PDF/PMN-FMI_wp060903.pdf, accessed Apr. 27, 2010.

Image of GUI on iPhone showing options for calling, http://cdn.content.compendiumblog.com/uploads/user/19dc41fd-9692-444d-81ee-e9a49e34471a/88f333a7-94e6-4fe8-8257-e2655134a168/Image/5a79a047453726ec5bf8a6628f37d112.jpg, accessed Nov. 8, 2010.

DiVitas Networks, DiVitas Mobile Unified Communications datasheet, 2010, http://www.divitas.com/pdfs/DiVitas_Mobile_UC_Datasheet.pdf, accessed Apr. 27, 2010.

D2 Technologies, Inc., mCUE mobile convergence software solution, 2007, http://www.d2tech.com/1-products/mcue.htm, accessed Nov. 8, 2010.

OnRelay, Inc., "Unified MBX Product Sheet", 2010, retrieved from http://www.onrelay.com/index.php?id=199 (download link on this page), accessed Apr. 27, 2010.

Extended European Search Report dated Nov. 11, 2010 from EP10170746.1.

Biggs, J.: "Skype for iPhone officially official [Update]", Internet Citation, Mar. 30, 2009, p. 1, XP007915606, retrieved from the Internet on Nov. 4, 2010 (http://www.crunchgear.com/2009/03/30/skype-for-iphone-officially-official).

* cited by examiner

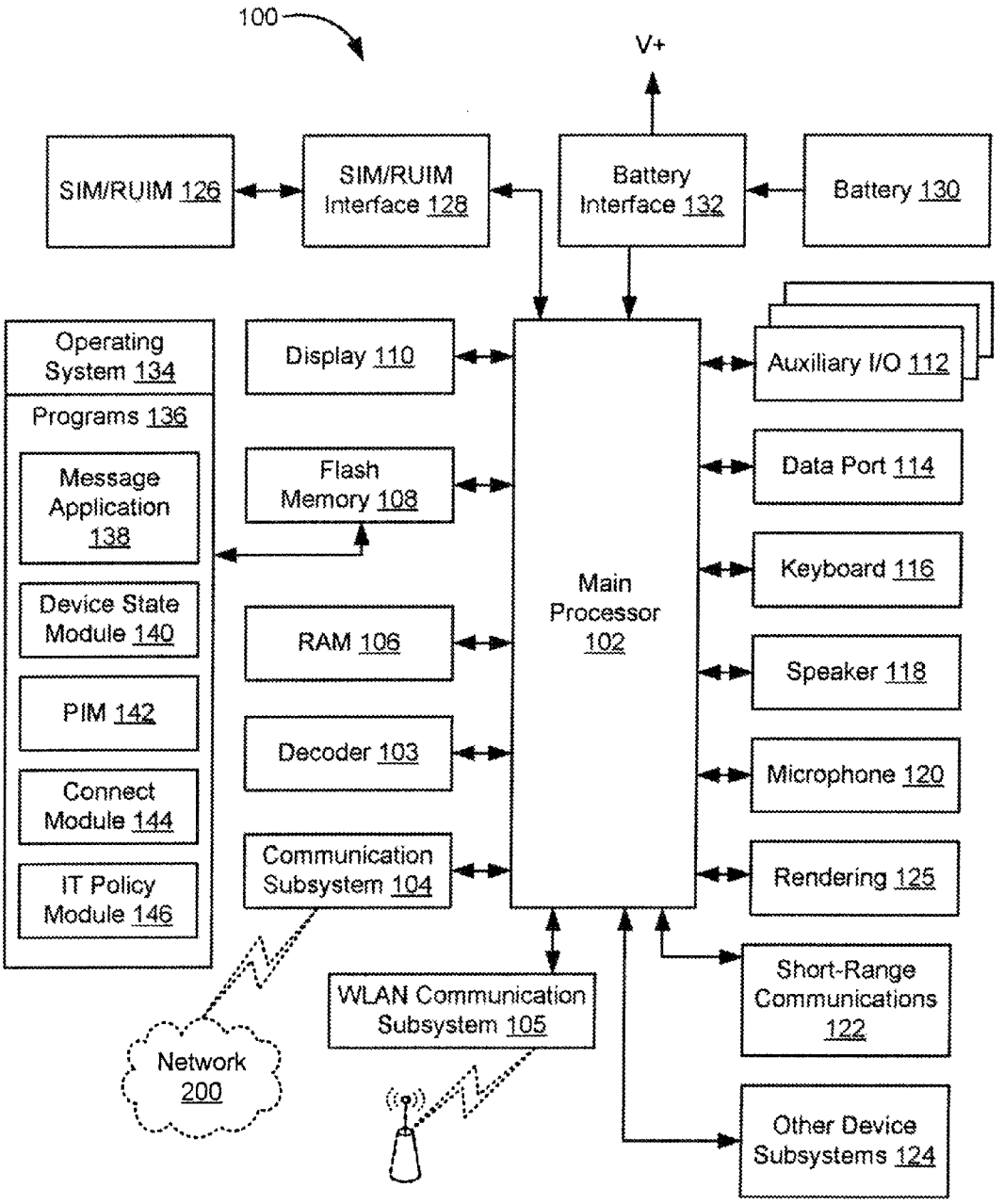

100
V+
SIM/RUIM 126
SIM/RUIM Interface 128
Battery Interface 132
Battery 130
Operating System 134
Programs 136
Message Application 138
Device State Module 140
PIM 142
Connect Module 144
IT Policy Module 146
Display 110
Flash Memory 108
RAM 106
Decoder 103
Communication Subsystem 104
Main Processor 102
Auxiliary I/O 112
Data Port 114
Keyboard 116
Speaker 118
Microphone 120
Rendering 125
Short-Range Communications 122
Other Device Subsystems 124
WLAN Communication Subsystem 105
Network 200

FIG. 1

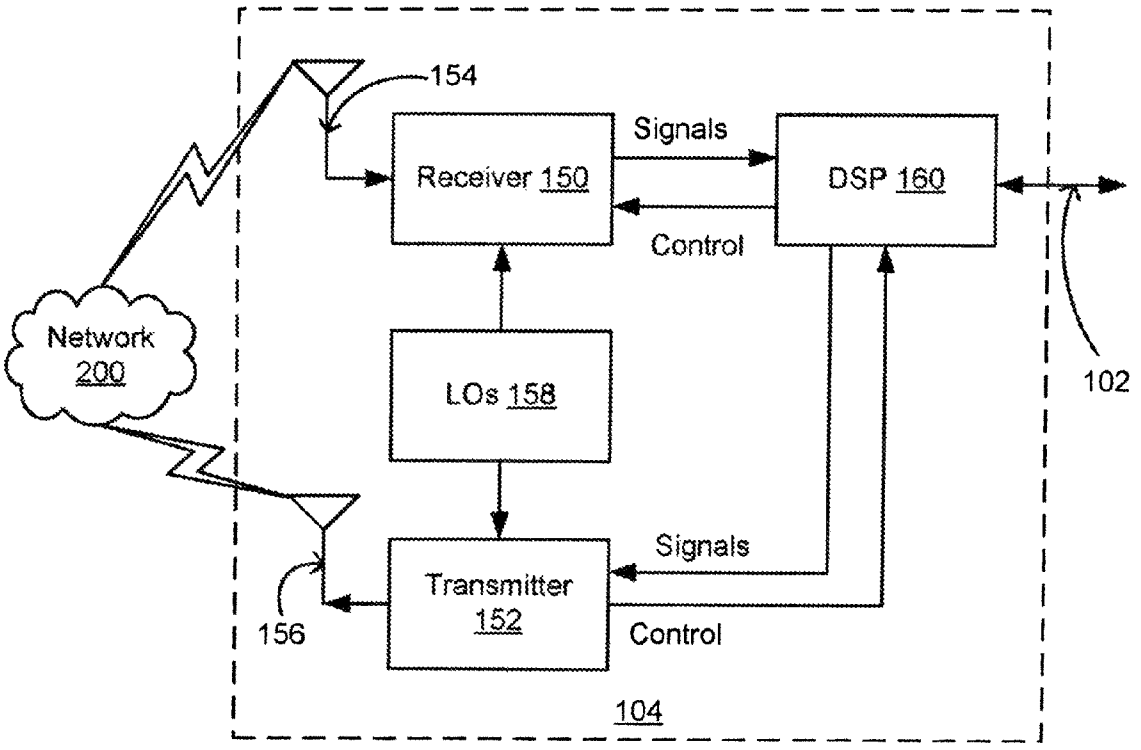

154
Receiver 150
Signals
DSP 160
Control
Network
200
LOs 158
102
Signals
Transmitter
152
156
Control
104

FIG. 2

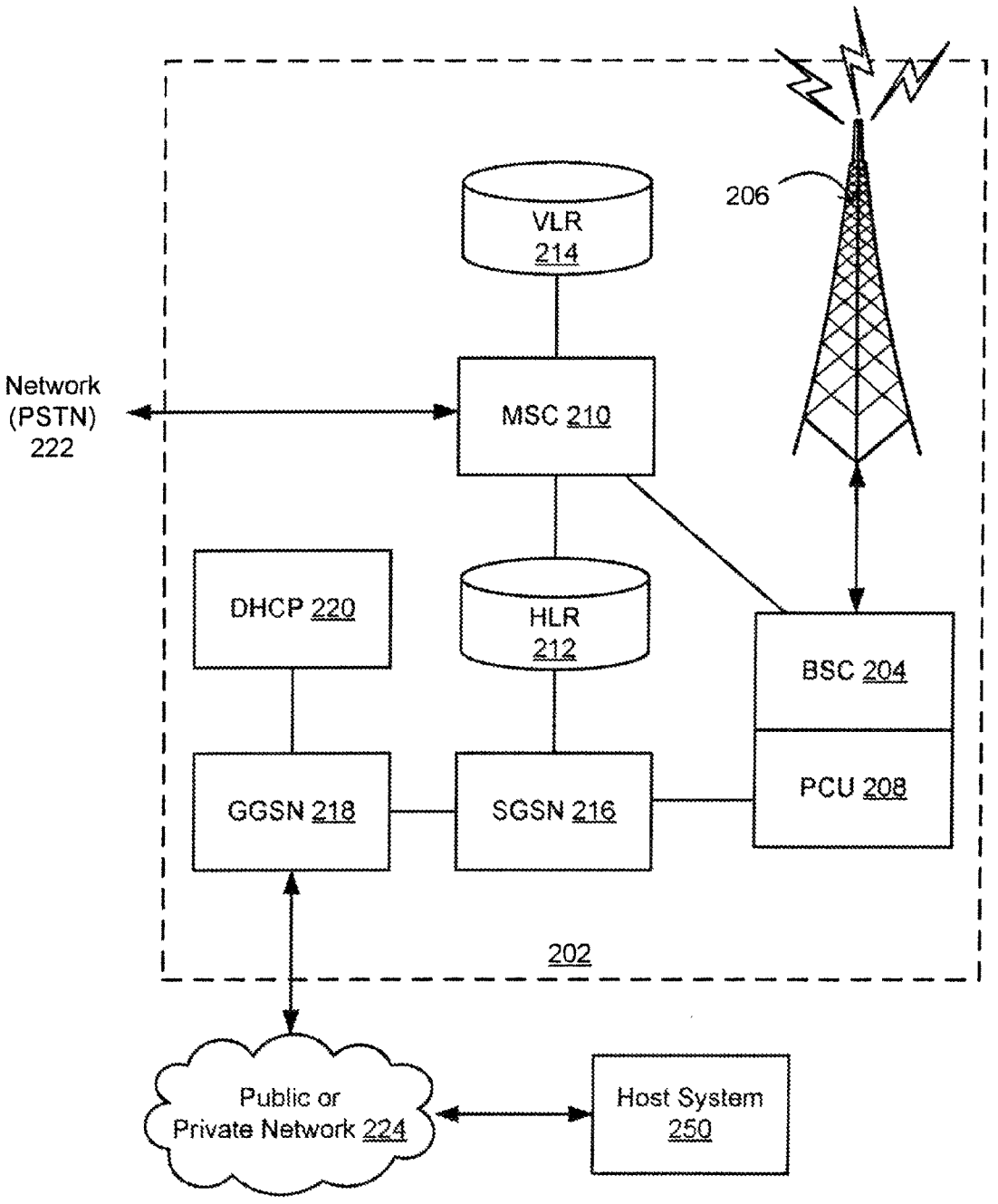

206
VLR
214
Network
(PSTN)
222
MSC 210
DHCP 220
HLR
212
BSC 204
PCU 208
GGSN 218
SGSN 216
202
Public or
Private Network 224
Host System
250

FIG. 3

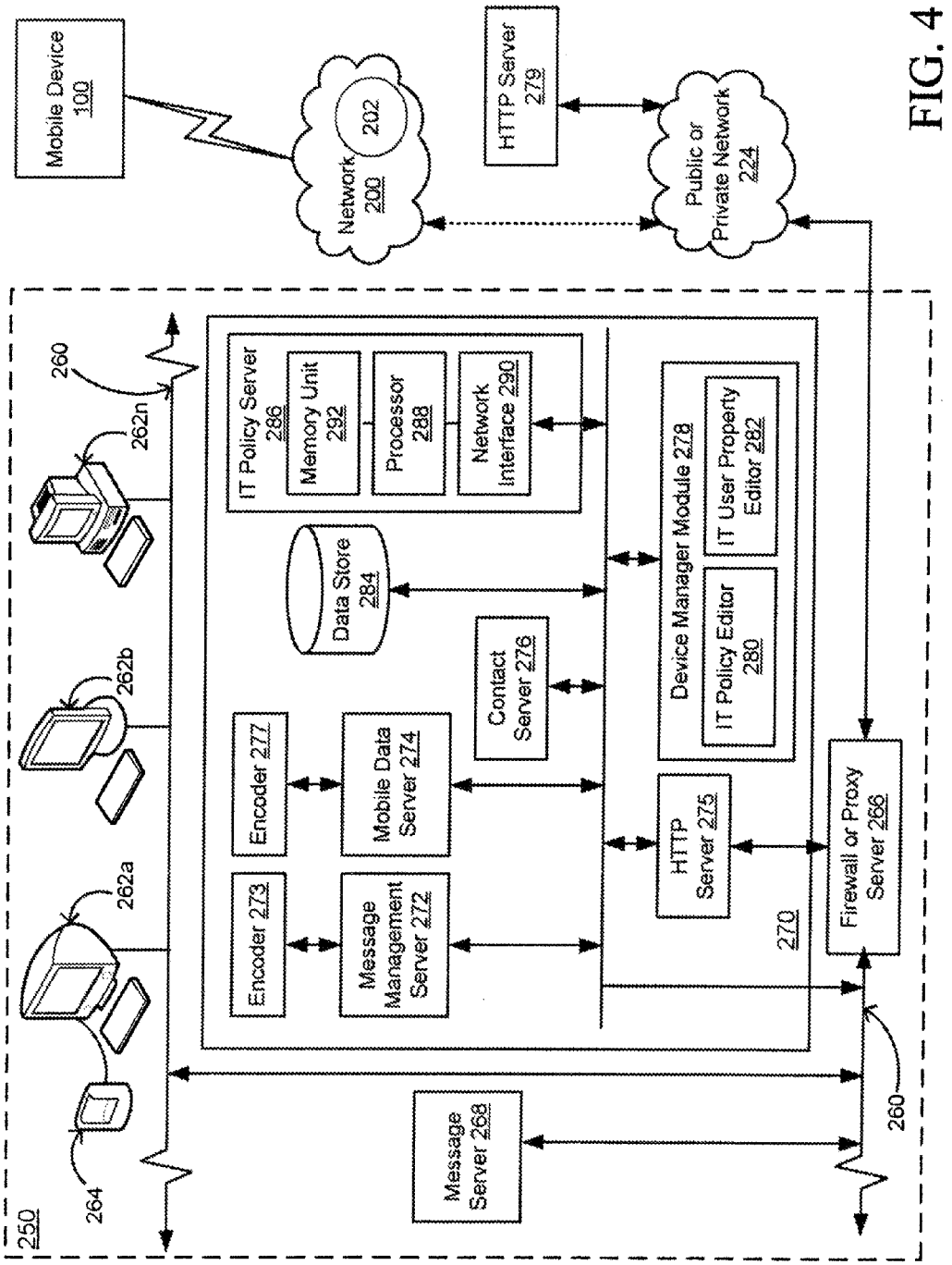

Mobile Device 100
Network 200
202
HTTP Server 279
Public or Private Network 224
250
260
262n
262b
262a
264
IT Policy Server 286
Memory Unit 292
Processor 288
Network Interface 290
Data Store 284
Contact Server 276
Device Manager Module 278
IT User Property Editor 282
IT Policy Editor 280
Encoder 277
Mobile Data Server 274
Encoder 273
Message Management Server 272
HTTP Server 275
270
Firewall or Proxy Server 266
Message Server 268

FIG. 4

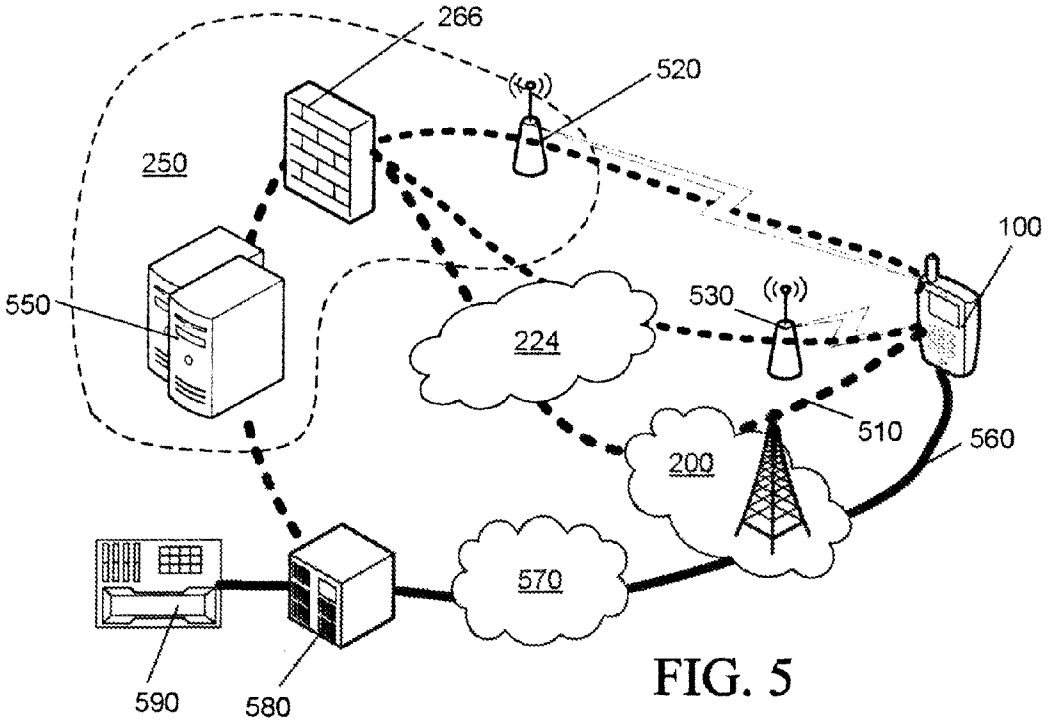


FIG. 5

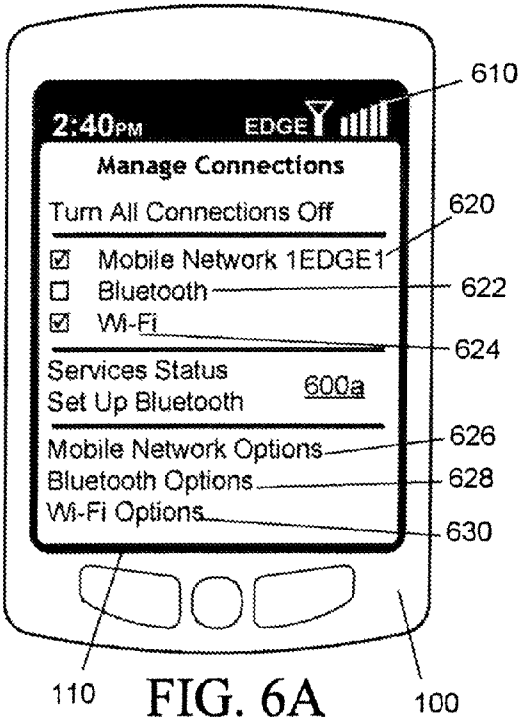


FIG. 6A

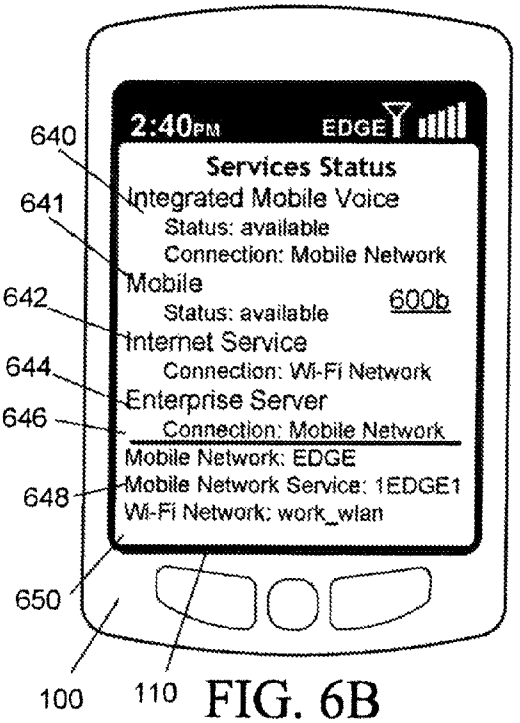


FIG. 6B

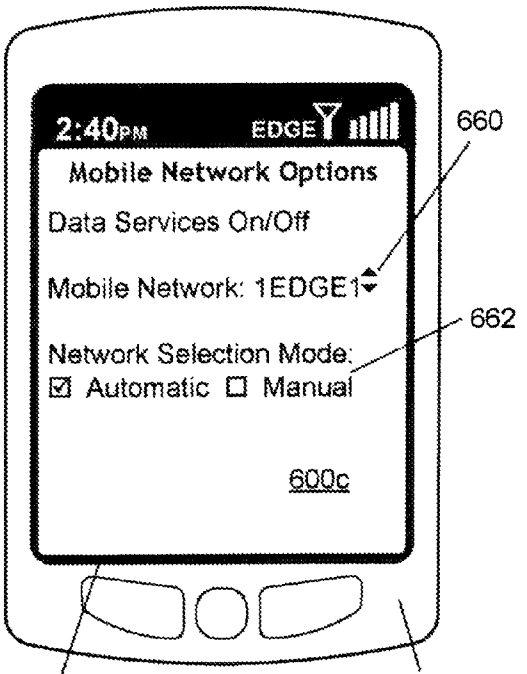


FIG. 6C

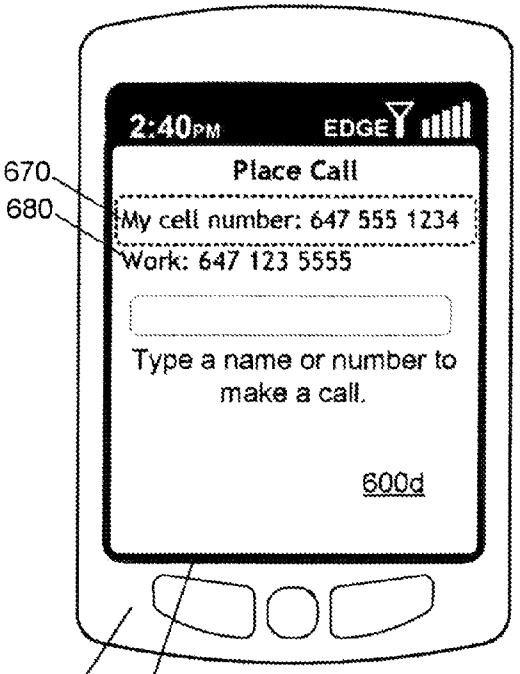


FIG. 6D

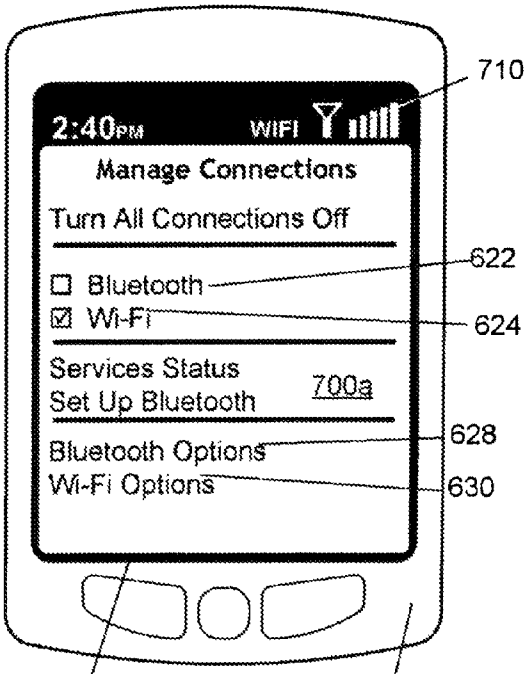


FIG. 7A

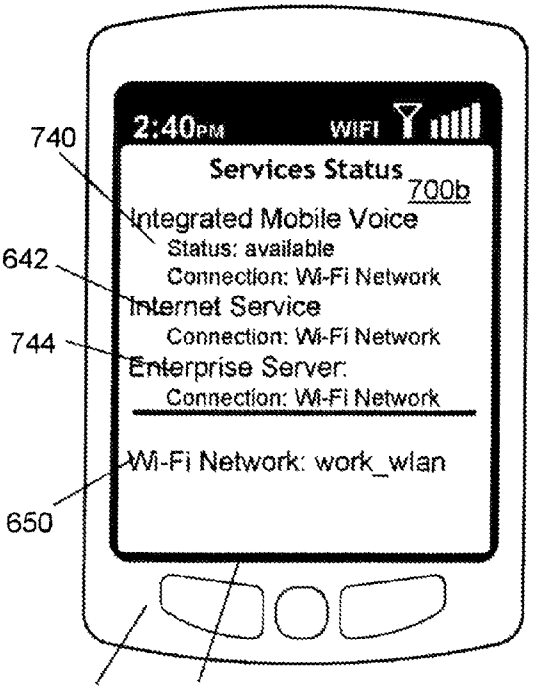


FIG. 7B

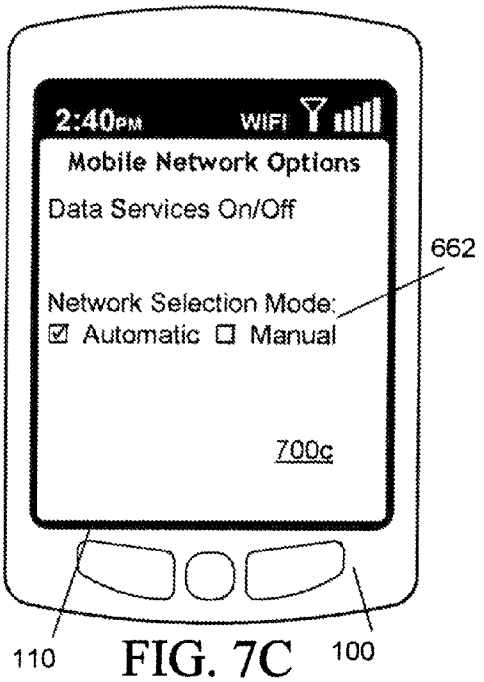


FIG. 7C

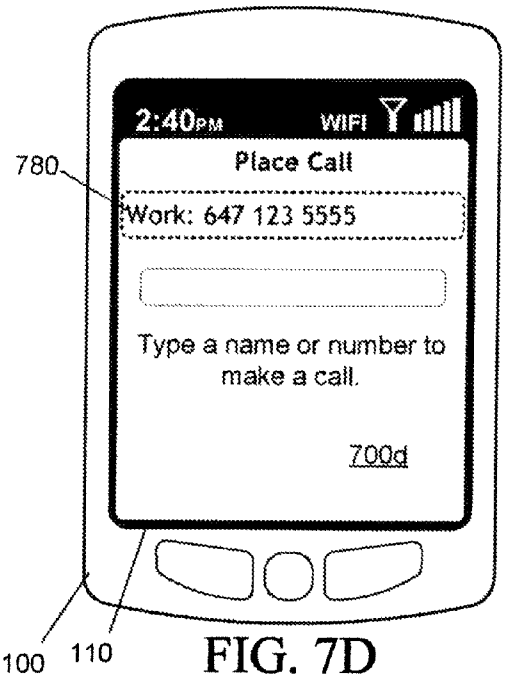


FIG. 7D

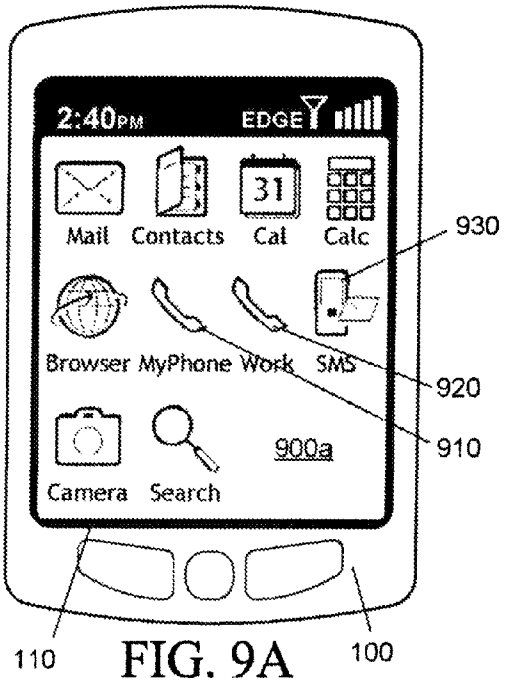


FIG. 9A

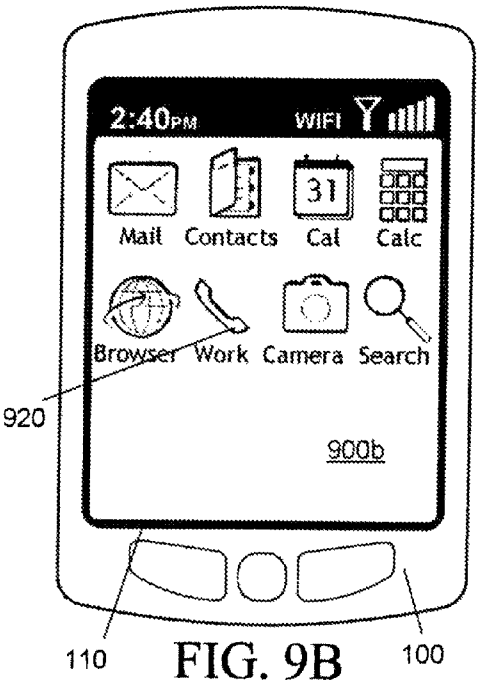


FIG. 9B

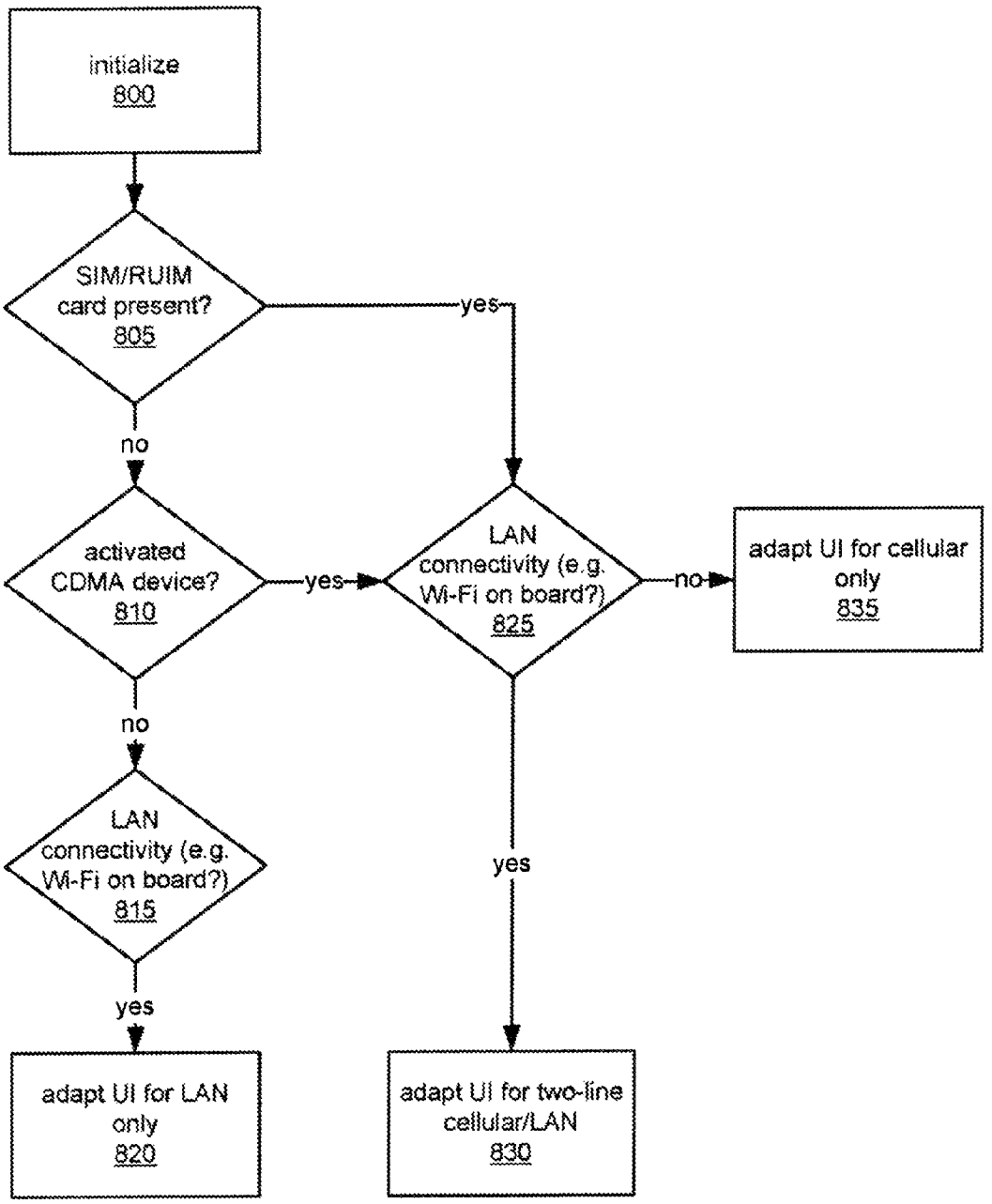

initialize
800
SIM/RUIM card present?
805
yes
no
activated CDMA device?
810
yes
LAN connectivity (e.g. Wi-Fi on board?)
825
no
adapt UI for cellular only
835
no
LAN connectivity (e.g. Wi-Fi on board?)
815
yes
yes
adapt UI for LAN only
820
adapt UI for two-line cellular/LAN
830

FIG. 8

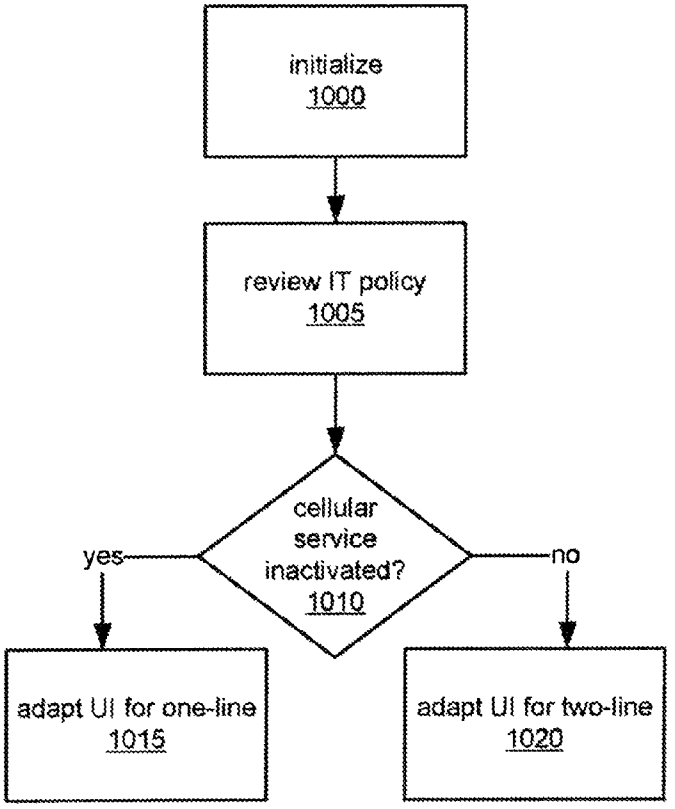

initialize
1000
review IT policy
1005
cellular service inactivated?
1010
yes
no
adapt UI for one-line
1015
adapt UI for two-line
1020

FIG. 10

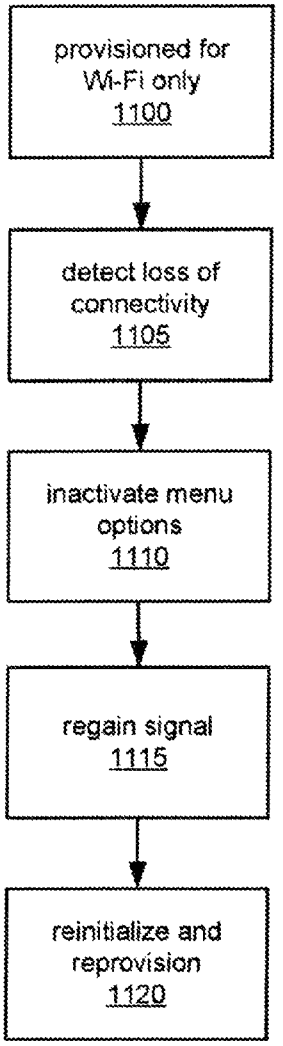

provisioned for Wi-Fi only
1100
detect loss of connectivity
1105
inactivate menu options
1110
regain signal
1115
reinitialize and reprovision
1120

FIG. 11

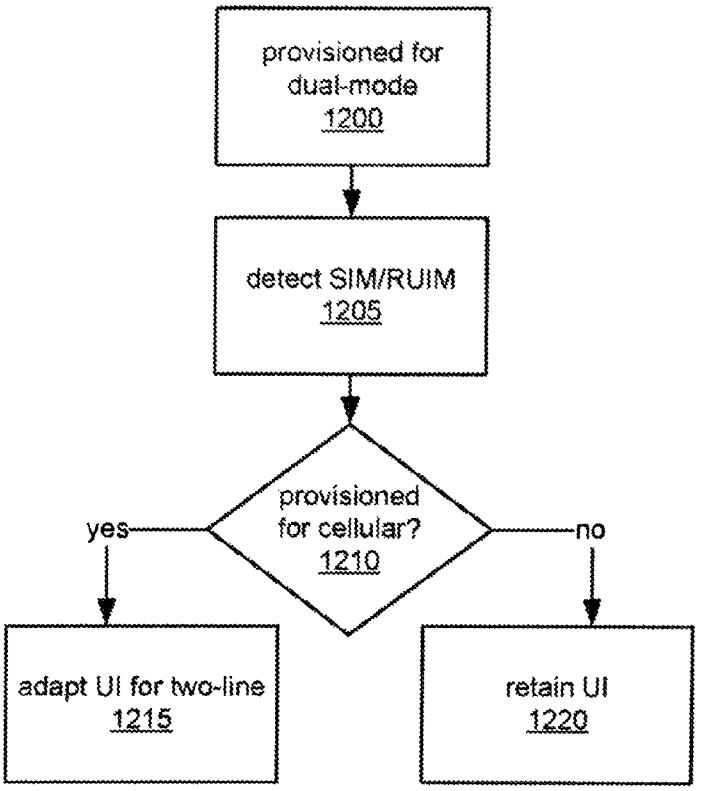

provisioned for dual-mode 1200
detect SIM/RUIM 1205
provisioned for cellular? 1210
yes
no
adapt UI for two-line 1215
retain UI 1220

FIG. 12

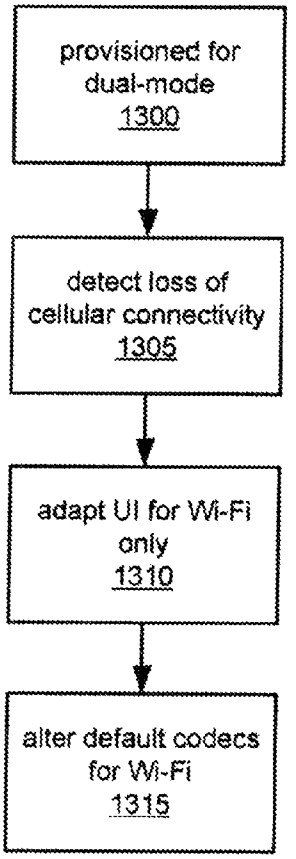

provisioned for dual-mode 1300
detect loss of cellular connectivity 1305
adapt UI for Wi-Fi only 1310
alter default codecs for Wi-Fi 1315

FIG. 13

CONVERSION OF MOBILE DEVICE TO LAN-ONLY TELEPHONY FUNCTIONS

REFERENCE TO PRIOR APPLICATIONS

This application claims priority from U.S. Application No. 61/328,097, filed Apr. 26, 2010.

BACKGROUND

1. Technical Field

The present application relates generally to management of enterprise telephony at a mobile device.

2. Description of the Related Art

Mobile communication devices, such as smartphones, may be used to extend the flexibility of fixed telephone networks within an enterprise. For example, dual-mode smartphones capable of operating over both cellular and IP-based networks may be deployed in an enterprise communication network equipped with a private branch exchange (PBX). The network may then route incoming telephone calls to the smartphone, and outbound calls from the smartphone may appear to the recipient to originate from the user's desk telephone connected to the PBX. The fixed mobile convergence realized by integrating mobile devices into the enterprise's PBX provides for an improved user experience both for the mobile device users and callers, since the system may extend desk phone functionality, such as conference calling, to the mobile device, and also because the mobile device user may appear to be available and "in the office" even when travelling.

Although voice calls made using dual-mode smartphones are typically connected over a cellular network, voice calls may also be completed using Voice over IP (VoIP) protocols over an IP-based network. Thus, for example, if a wireless LAN (LAN) connection is available to the smartphone, telephone calls may be routed over the LAN.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate by way of example only embodiments of the present application,

FIG. **1** is a block diagram of an embodiment of a mobile device.

FIG. **2** is a block diagram of an embodiment of a communication subsystem component of the mobile device of FIG. **1**.

FIG. **3** is an exemplary block diagram of a node of a wireless network for use with the mobile device of FIG. **1**.

FIG. **4** is a block diagram illustrating components of a host system in one exemplary configuration for use with the wireless network of FIG. **3** and the mobile device of FIG. **1**.

FIG. **5** is a schematic diagram of a network topology for use with the mobile device of FIG. **1**.

FIGS. **6**A through **6**D are schematic diagrams of graphical user interfaces for the mobile device of FIG. **1**.

FIGS. **7**A through **7**D are further diagrams of graphical user interfaces for the mobile device of FIG. **1**.

FIG. **8** is a flowchart for a method of adapting the user interface of the mobile device.

FIGS. **9**A and **9**B are further examples of graphical user interfaces for the mobile device.

FIG. **10** is a flowchart illustrating a further method for adapting the user interface of the mobile device.

FIG. **11** is a flowchart illustrating a method for handling a detected loss of connectivity.

FIG. **12** is a flowchart illustrating a further method for adapting the user interface of the mobile device.

FIG. **13** is a flowchart illustrating a method for adapting the default codecs at the mobile device.

DETAILED DESCRIPTION

The embodiments described herein provide a system, method, and a mobile device for providing for a convergence of fixed and mobile voice communications in an enterprise environment, while providing a dynamically adjusting user interface responsive to network conditions at the mobile device. There is provided a mobile device configurable for communication over at least one cellular network and over at least on local area network (LAN), the mobile device being adapted for voice communication using at least one mobile telecommunications standard and at least one IP-based network, capable of implementing a method of determining whether the mobile device is configured for communication over a cellular network connection, determining whether the mobile device is configured for communication over a LAN, and in some embodiments a wireless LAN, and adapting a user interface at the mobile device to reflect voice communication availability only over those connections for which the mobile device is determined to be configured. In some aspects, determining whether the mobile device is configured for communication over the cellular network connection may comprise at least one of determining whether a SIM or RUIM card is present in the mobile device, determining whether the mobile device is an activated CDMA device, or determining whether cellular connectivity has been inactivated at the mobile device. Determining whether the mobile device is configured for LAN or wireless LAN communication may comprise determining whether there is an appropriate communications subsystem on board.

Thus, the user interface may therefore be adapted to reflect voice communication availability only over the LAN connection when the mobile device is determined not to be configured for communication over the cellular network but configured for LAN connectivity; voice communication availability only over the cellular network connection when the mobile device is determined to be configured for such communication, but not for communication over the LAN; or if both forms of connectivity are available, the user interface may reflect the availability of voice communication over both.

In these embodiments, availability of voice communication over one or the other path may be indicated by displaying service entry points in the user interface for those available connections, or by displaying a telephone number only for those connections for which the mobile device is configured. In a further aspect of these embodiments, the mobile device may be initially configured for voice communication over the cellular network connection and the LAN connection, but upon detection of a loss of cellular network connectivity, the mobile device may adapt the user interface to reflect voice communication availability only over the LAN connection. In still a further aspect, the mobib device may be adapted to use one set of codecs for voice communication over the cellular network, and may then select a second set of codecs for voice communication over the LAN connection upon detecting the loss of cellular network connectivity. In yet a further aspect, the mobile device may be configured to place and receive voice calls via a PBX over either the cellular network, the LAN connection, or both.

These embodiments will be described primarily in relation to a mobile wireless communication device such as a smartphone, hereafter referred to as a mobile device. It will be appreciated by those skilled in the art, however, that this description is not intended to limit the scope of the described

embodiments to smartphones. The methods and systems described herein may be applied to any appropriate communication or data processing device, whether portable or not, including without limitation cellular phones, smartphones, organizers, personal digital assistants, desktop computers, terminals, laptops, tablets, notebook computers and the like.

The embodiments described herein may be implemented on a communication device such as that illustrated in FIGS. **1** and **2**. The communication device may communicate with other devices over a wireless communication system or enterprise system as illustrated in FIGS. **3** and **4**. The communication device **100** may be a mobile device with two-way communication and advanced data communication capabilities including the capability to communicate with other mobile devices or computer systems through a network of transceiver stations. The communication device **100** can also have voice communication capabilities.

FIG. **1** is a block diagram of an exemplary embodiment of a communication device **100**. The communication device **100** includes a number of components such as a main processor **102** that controls the overall operation of the communication device **100**. Communication functions, including data and voice communications, are performed through a communication subsystem **104**. Data received by the communication device **100** can be decompressed and decrypted by decoder **103**, operating according to any suitable decompression techniques, and encryptioridecryption techniques according to various standards, such as Data Encryption Standard (DES), Triple DES, or Advanced Encryption Standard (AES)). Image data is typically compressed and decompressed in accordance with appropriate standards, such as JPEG, while video data is typically compressed and decompressed in accordance with appropriate standards, such as H.26x and MPEG-x series standards.

The communication subsystem **104** receives messages from and sends messages to a wireless network **200**. In this exemplary embodiment of the communication device **100**, the communication subsystem **104** is configured in accordance with one or more of Global System for Mobile Communication (GSM), General Packet Radio Services (GPRS) standards, Enhanced Data GSM Environment (EDGE) and Universal Mobile Telecommunications Service (UMTS). New standards are still being defined, but it is believed that they will have similarities to the network behavior described herein, and it will also be understood by persons skilled in the art that the embodiments described herein are intended to use any other suitable standards that are developed in the future. The wireless link connecting the communication subsystem **104** with the wireless network **200** represents one or more different Radio Frequency (RF) channels, operating according to defined protocols specified for GSM, GPRS, EDGE, or UMTS, and optionally other network communications. With newer network protocols, these channels are capable of supporting both circuit switched voice communications and packet switched data communications.

Other wireless networks can also be associated with the communication device **100** in variant implementations. The different types of wireless networks that can be employed include, for example, data-centric wireless networks, voice-centric wireless networks, and dual-mode networks that can support both voice and data communications over the same physical base stations. Combined dual-mode networks include, but are not limited to, Code Division Multiple Access (CDMA) or CDMA2000 networks, GSM/GPRS networks, third-generation (3G) networks like EDGE, HSPA, HSPA+, EVDO and UMTS, or fourth-generation (4G) networks such as LTE and LTE Advanced. Some other examples of data-centric networks include WiFi 802.11™, Mobitex™ and DataTAC™ network communication systems. Examples of other voice-centric data networks include Personal Communication Systems (PCS) networks like GSM and Time Division Multiple Access (TDMA) systems. The mobile device **100** may be provided with additional communication subsystems, such as the wireless LAN (WLAN) communication subsystem **105** also shown in FIG. **1**. The WLAN communication subsystem may operate in accordance with a known network protocol such as one or more of the 802.11™ family of standards developed by IEEE. The communication subsystem **105** may be separate from, or integrated with, the communication subsystem **104** or with the short-range communications module **122**. The main processor **102** also interacts with additional subsystems such as a Random Access Memory (RAM) **106**, a flash memory **108**, a display **110**, an auxiliary input/output (I/O) subsystem **112**, a data port **114**, a keyboard **116**, a speaker **118**, a microphone **120**, the short-range communications **122** and other device subsystems **124**.

Some of the subsystems of the communication device **100** perform communication-related functions, whereas other subsystems can provide "resident" or on-device functions. By way of example, the display **110** and the keyboard **116** can be used for both communication-related functions, such as entering a text message for transmission over the network **200**, and device-resident functions such as a calculator or task list.

A rendering circuit **125** is included in the device **100**. When a user specifies that a data file is to be viewed on the display **110**, the rendering circuit **125** analyzes and processes the data file for visualization on the display **110**. Rendering circuit **125** may be implemented as hardware, software, or as a combination of both hardware and software.

The communication device **100** can send and receive communication signals over the wireless network **200** after required network registration or activation procedures have been completed. Network access is associated with a subscriber or user of the communication device **100**. To identify a subscriber, the communication device **100** requires a SIM/RUIM card **126** (i.e. Subscriber Identity Module or a Removable User Identity Module) to be inserted into a SIM/RUIM interface **128** in order to communicate with a network. The SIM/RUIM card **126** is one type of a conventional "smart card" that can be used to identify a subscriber of the communication device **100** and to personalize the communication device **100**, among other things. Without the SIM/RUIM card **126**, the communication device **100** is not fully operational for communication with the wireless network **200**. By inserting the SIM/RUIM card **126** into the SIM/RUIM interface **128**, a subscriber can access all subscribed services. Services can include: web browsing and messaging such as e-mail, voice mail, Short Message Service (SMS), and Multimedia Messaging Services (MMS). More advanced services can include: point of sale, field service and sales force automation. The SIM/RUIM card **126** includes a processor and memory for storing information. Once the SIM/RUIM card **126** is inserted into the SIM/RUIM interface **128**, it is coupled to the main processor **102**. In order to identify the subscriber, the SIM/RUIM card **126** can include some user parameters such as an International Mobile Subscriber Identity (IMSI). An advantage of using the SIM/RUIM card **126** is that a subscriber is not necessarily bound by any single physical mobile device. The SIM/RUIM card **126** can store additional subscriber information for a mobile device as well, including datebook (or calendar) information and recent call information. Alternatively, user identification information can also be programmed into the flash memory **108**.

The communication device **100** may be a battery-powered device including a battery interface **132** for receiving one or more rechargeable batteries **130**. In at least some embodiments, the battery **130** can be a smart battery with an embedded microprocessor. The battery interface **132** is coupled to a regulator (not shown), which assists the battery **130** in providing power V+ to the communication device **100**. Although current technology makes use of a battery, future technologies such as micro fuel cells can provide the power to the communication device **100**.

The communication device **100** also includes an operating system **134** and software components **136** to **146** which are described in more detail below. The operating system **134** and the software components **136** to **146** that are executed by the main processor **102** are typically storod in a persistent store such as the flash memory **108**, which can alternatively be a read-only memory (ROM) or similar storage element (not shown). Those skilled in the art will appreciate that portions of the operating system **134** and the software components **136** to **146**, such as specific device applications, or parts thereof, can be temporarily loaded into a volatile store such as the RAM **106**. Other software components can also be included, as is well known to those skilled in the art.

The subset of software applications **136** that control basic device operations, including data and voice communication applications, will normally be installed on the communication device **100** during its manufacture. Other software applications include a message application **138** that can be any suitable software program that allows a user of the communication device **100** to send and receive electronic messages. Various alternatives exist for the message application **138** as is well known to those skilled in the art. Messages that have been sent or received by the user are typically stored in the flash memory **108** of the communication device **100** or some other suitable storage element in the communication device **100**. In at least some embodiments, some of the sent and received messages can be stored remotely from the device **100** such as in a data store of an associated host system that the communication device **100** communicates with.

The software applications can further include a device state module **140**, a Personal Information Manager (PIM) **142**, and other suitable modules (not shown). The device state module **140** provides persistence, i.e. the device state module **140** ensures that important device data is stored in persistent memory, such as the flash memory **108**, so that the data is not lost when the communication device **100** is turned off or loses power.

The PIM **142** includes functionality for organizing and managing data items of interest to the user, such as, but not limited to, e-mail, contacts, calendar events, voice mails, appointments, and task items. A PIM application has the ability to send and receive data items via the wireless network **200**. PIM data items can be seamlessly integrated, synchronized, and updated via the wireless network **200** with the mobile device subscriber's corresponding data items stored and/or associated with a host computer system. This functionality creates a mirrored host computer on the communication device **100** with respect to such items. This can be particularly advantageous when the host computer system is the mobile device subscriber's office computer system.

The communication device **100** also includes a connect module **144**, and an information technology (IT) policy module **146**. The connect module **144** implements the communication protocols that are required for the communication device **100** to communicate with the wireless infrastructure and any host system, such as an enterprise system, that the communication device **100** is authorized to interface with. Examples of a wireless infrastructure and an enterprise system are given in FIGS. **3** and **4**, which are described in more detail below.

The connect module **144** includes a set of Application Programming Interfaces (APIs) that can be integrated with the communication device **100** to allow the communication device **100** to use any number of services associated with the enterprise system. The connect module **144** allows the communication device **100** to establish an end-to-end secure, authenticated communication pipe with the host system. A subset of applications for which access is provided by the connect module **144** can be used to pass IT policy commands from the host system to the communication device **100**. This can be done in a wireless or wired manner.

These instructions can then be passed to the IT policy module **146** to modify the configuration of the device **100**. Alternatively, in some cases, the IT policy update can also be done over a wired connection.

Other types of software applications can also be installed on the communication device **100**. These software applications can be third party applications, which are added after the manufacture of the communication device **100**. Examples of third party applications include games, calculators, utilities, etc.

The additional applications can be loaded onto the communication device **100** through at least one of the wireless network **200**, the auxiliary **110** subsystem **112**, the data port **114**, the short-range communications subsystem **122**, or any other suitable device subsystem **124**. This flexibility in application installation increases the functionality of the communication device **100** and can provide enhanced on-device functions, communication-related functions, or both. For example, secure communication applications can enable electronic commerce functions and other such financial transactions to be performed using the communication device **100**.

The data port **114** enables a subscriber to set preferences through an external device or software application and extends the capabilities of the communication device **100** by providing for information or software downloads to the communication device **100** other than through a wireless communication network. The alternate download path can, for example, be used to load an encryption key onto the communication device **100** through a direct and thus reliable and trusted connection to provide secure device communication. The data port **114** can be any suitable port that enables data communication between the communication device **100** and another computing device. The data port **114** can be a serial or a parallel port. In some instances, the data port **114** can be a USB port that includes data lines for data transfer and a supply line that can provide a charging current to charge the battery **130** of the communication device **100**.

The short-range communications subsystem **122** provides for communication between the communication device **100** and different systems or devices, without the use of the wireless network **200**. For example, the subsystem **122** can include an infrared device and associated circuits and components for short-range communication. Examples of short-range communication standards include standards developed by the Infrared Data Association (IrDA), Bluetooth™, and the 802.11™ family of standards.

In use, a received signal such as a text message, an e-mail message, or web page download will be processed by the communication subsystem **104** and input to the main processor **102**. The main processor **102** will then process the received signal for output to the display **110** or alternatively to the auxiliary I/O subsystem **112**. A subscriber can also compose data items, such as e-mail messages, for example, using

the keyboard **116** in conjunction with the display **110** and possibly the auxiliary I/O subsystem **112**. The auxiliary subsystem **112** can include devices such as: a touchscreen, mouse, track ball, infrared fingerprint detector, or a roller wheel with dynamic button pressing capability. The keyboard **116** may be an alphanumeric keyboard and/or telephone-type keypad. However, other types of keyboards can also be used. A composed item can be transmitted over the wireless network **200** through the communication subsystem **104**. It will be appreciated that if the display **110** comprises a touchscreen, then the auxiliary subsystem **112** may still comprise one or more of the devices identified above.

For voice communications, the overall operation of the communication device **100** is substantially similar, except that the received signals are output to the speaker **118**, and signals for transmission are generated by the microphone **120**. Alternative voice or audio I/O subsystems, such as a voice message recording subsystem, can also be implemented on the communication device **100**. Although voice or audio signal output is accomplished primarily through the speaker **118**, the display **110** can also be used to provide additional information such as the identity of a calling party, duration of a voice call, or other voice call related information.

FIG. **2** shows an exemplary block diagram of the communication subsystem component **104**. The communication subsystem **104** includes a receiver **150**, a transmitter **152**, as well as associated components such as one or more embedded or internal antenna elements **154** and **156**, Local Oscillators (LOs) **158**, and a processing module such as a Digital Signal Processor (DSP) **160**. The particular design of the communication subsystem **104** is dependent upon the communication network **200** with which the communication device **100** is intended to operate. Thus, it should be understood that the design illustrated in FIG. **2** serves only as one example.

Signals received by the antenna **154** through the wireless network **200** are input to the receiver **150**, which can perform such common receiver functions as signal amplification, frequency down conversion, filtering, channel selection, and analog-to-digital (A/D) conversion. AID conversion of a received signal allows more complex communication functions such as demodulation and decoding to be performed in the DSP **160**. In a similar manner, signals to be transmitted are processed, including modulation and encoding, by the DSP **160**. These DSP-processed signals are input to the transmitter **152** for digital-to-analog (D/A) conversion, frequency up conversion, filtering, amplification and transmission over the wireless network **200** via the antenna **156**. The DSP **160** not only processes communication signals, but also provides for receiver and transmitter control. For example, the gains applied to communication signals in the receiver **150** and the transmitter **152** can be adaptively controlled through automatic gain control algorithms implemented in the DSP **160**.

The wireless link between the communication device **100** and the wireless network **200** can contain one or more different channels, typically different RF channels, and associated protocols used between the communication device **100** and the wireless network **200**. An RF channel is a limited resource that should be conserved, typically due to limits in overall bandwidth and limited battery power of the communication device **100**. When the communication device **100** is fully operational, the transmitter **152** is typically keyed or turned on only when it is transmitting to the wireless network **200** and is otherwise turned off to conserve resources. Similarly, the receiver **150** is periodically turned off to conserve power until it is needed to receive signals or information (if at all) during designated time periods. Other communication subsystems, such as the WLAN communication subsystem **105** shown in FIG. **1**, may be provided with similar components as those described above configured for communication over the appropriate frequencies and using the appropriate protocols.

FIG. **3** is a block diagram of an exemplary implementation of a node **202** of the wireless network **200**. In practice, the wireless network **200** comprises one or more nodes **202**. In conjunction with the connect module **144**, the communication device **100** can communicate with the node **202** within the wireless network **200**. In the exemplary implementation of FIG. **3**, the node **202** is configured in accordance with General Packet Radio Service (GPRS) and Global Systems for Mobile (GSM) technologies. The node **202** includes abase station controller (BSC) **204** with an associated tower station **206**, a Packet Control Unit (PCU) **208** added for GPRS support in GSM, a Mobile Switching Center (MSC) **210**, a Home Location Register (HLR) **212**, a Visitor Location Registry (VLR) **214**, a Serving GPRS Support Node (SGSN) **216**, a Gateway GPRS Support Node (GGSN) **218**, and a Dynamic Host Configuration Protocol (DHCP) **220**. This list of components is not meant to be an exhaustive list of the components of every node **202** within a GSM/GPRS network, but rather a list of components that are commonly used in communications through the network **200**.

In a GSM network, the MSC **210** is coupled to the BSC **204** and to a landline network, such as a Public Switched Telephone Network (PSTN) **222** to satisfy circuit switched requirements. The connection through the PCU **208**, the SGSN **216** and the GGSN **218** to a public or private network (Internet) **224** (also referred to herein generally as a shared network infrastructure) represents the data path for GPRS capable mobile devices. In a GSM network extended with GPRS capabilities, the BSC **204** also contains the Packet Control Unit (PCU) **208** that connects to the SGSN **216** to control segmentation, radio channel allocation and to satisfy packet switched requirements. To track the location of the communication device **100** and availability for both circuit switched and packet switched management, the HLR **212** is shared between the MSC **210** and the SGSN **216**. Access to the VLR **214** is controlled by the MSC **210**.

The station **206** is a fixed transceiver station and together with the BSC **204** form fixed transceiver equipment. The fixed transceiver equipment provides wireless network coverage for a particular coverage area commonly referred to as a "cell". The fixed transceiver equipment transmits communication signals to and receives communication signals from mobile devices within its cell via the station **206**. The fixed transceiver equipment normally performs such functions as modulation and possibly encoding and/or encryption of signals to be transmitted to the communication device **100** in accordance with particular, usually predetermined, communication protocols and parameters, under control of its controller. The fixed transceiver equipment similarly demodulates and possibly decodes and decrypts, if necessary, any communication signals received from the communication device **100** within its cell. Communication protocols and parameters can vary between different nodes. For example, one node can employ a different modulation scheme and operate at different frequencies than other nodes.

For all communication devices **100** registered with a specific network, permanent configuration data such as a user profile is stored in the HLR **212**. The HLR **212** also contains location information for each registered mobile device and can be queried to determine the current location of a mobile device. The MSC **210** is responsible for a group of location areas and stores the data of the mobile devices currently in its area of responsibility in the VLR **214**. Further, the VLR **214** also contains information on mobile devices that are visiting

other networks. The information in the VLR **214** includes part of the permanent mobile device data transmitted from the HLR **212** to the VLR **214** for faster access. By moving additional information from a remote HLR **212** node to the VLR **214**, the amount of traffic between these nodes can be reduced so that voice and data services can be provided with faster response times and at the same time requiring less use of computing resources.

The SGSN **216** and the GGSN **218** are elements added for GPRS support; namely packet switched data support, within GSM. The SGSN **216** and the MSC **210** have similar responsibilities within the wireless network **200** by keeping track of the location of each communication device **100**. The SGSN **216** also performs security functions and access control for data traffic on the wireless network **200**. The GGSN **218** provides internetworking connections with external packet switched networks and connects to one or more SGSNs **216** via an Internet Protocol (IP) backbone network operated within the network **200**. During normal operations, a given communication device **100** must perform a "GPRS Attach" to acquire an IP address and to access data services. This requirement is not present in circuit switched voice channels as Integrated Services Digital Network (ISDN) addresses are used for routing incoming and outgoing calls. Currently, all GPRS capable networks use private, dynamically assigned IP addresses, thus requiring the DHCP server **220** connected to the GGSN **218**. There are many mechanisms for dynamic IP assignment, including using a combination of a Remote Authentication Dial-In User Service (RADIUS) server and a DHCP server. Once the GPRS Attach is complete, a logical connection is established from a communication device **100**, through the PCU **208**, and the SGSN **216** to an Access Point Node (APN) within the GGSN **218**. The APN represents a logical end of an IP tunnel that can either access direct Internet compatible services or private network connections. The APN also represents a security mechanism for the network **200**, insofar as each communication device **100** must be assigned to one or more APNs and communication devices **100** cannot exchange data without first performing a GPRS Attach to an APN that it has been authorized to use. The APN can be considered to be similar to an Internet domain name such as "myconnection.wireless.com".

Once the GPRS Attach operation is complete, a tunnel is created and all traffic is exchanged within standard IP packets using any protocol that can be supported in IP packets. This includes tunneling methods such as IP over IP as in the case with some IPSecurity (Ipsec) connections used with Virtual Private Networks (VPN). These tunnels are also referred to as Packet Data Protocol (PDP) Contexts and there are a limited number of these available in the network **200**. To maximize use of the PDP Contexts, the network **200** will run an idle timer for each PDP Context to determine if there is a lack of activity. When a communication device **100** is not using its PDP Context, the PDP Context can be de-allocated and the IP address returned to the IP address pool managed by the DHCP server **220**.

FIG. **4** is a block diagram illustrating components of an exemplary configuration of a host system **250** with which the communication device **100** can communicate in conjunction with the connect module **144**. The host system **250** will typically be a corporate enterprise or other local area network (LAN), but can also be a home office computer or some other private system, for example, in variant implementations. In the example shown in FIG. **4**, the host system **250** is depicted as a LAN of an organization to which a user of the communication device **100** belongs. Typically, a plurality of mobile devices can communicate wirelessly with the host system **250** through one or more nodes **202** of the wireless network **200**.

The host system **250** comprises a number of network components connected to each other by a network **260**. For instance, a user's desktop computer **262***a* with an accompanying cradle **264** for the user's communication device **100** is situated on a LAN connection. The cradle **264** for the communication device **100** can be coupled to the computer **262***a* by a serial or a Universal Serial Bus (USB) connection, for example. Other user computers **262***b*-**262***n* are also situated on the network **260**, and each can be equipped with an accompanying cradle **264**. The cradle **264** facilitates the loading of information (e.g. PIM data, private symmetric encryption keys to facilitate secure communications) from the user computer **262***a* to the communication device **100**, and can be particularly useful for bulk information updates often performed in initializing the communication device **100** for use. The information downloaded to the communication device **100** can include certificates used in the exchange of messages.

It will be understood by persons skilled in the art that the user computers **262***a*-**262***n* are typically also connected to other peripheral devices, such as printers, etc., which are not explicitly shown in FIG. **4**. Furthermore, only a subset of network components of the host system **250** are shown in FIG. **4** for ease of exposition, and it will be understood by persons skilled in the art that the host system **250** will comprise additional components that are not explicitly shown in FIG. **4** for this exemplary configuration. More generally, the host system **250** can represent a smaller part of a larger network (not shown) of the organization, and can comprise different components and/or be arranged in different topologies than that shown in the exemplary embodiment of FIG. **4**.

To facilitate the operation of the communication device **100** and the wireless communication of messages and message-related data between the communication device **100** and components of the host system **250**, a number of wireless communication support components **270** can be provided. In some implementations, the wireless communication support components **270** can include a message management server **272**, a mobile data server **274**, a web server, such as Hypertext Transfer Protocol (HTTP) server **275**, a contact server **276**, and a device manager module **278**. HTTP servers can also be located outside the enterprise system, as indicated by the HTTP server **279** attached to the network **224**. The device manager module **278** includes an IT Policy editor **280** and an IT user property editor **282**, as well as other software components for allowing an IT administrator to configure the communication devices **100**. In an alternative embodiment, there can be one editor that provides the functionality of both the IT policy editor **280** and the IT user property editor **282**. The support components **270** also include a data store **284**, and an IT policy server **286**. The IT policy server **286** includes a processor **288**, a network interface **290** and a memory unit **292**. The processor **288** controls the operation of the IT policy server **286** and executes functions related to the standardized IT policy as described below. The network interface **290** allows the IT policy server **286** to communicate with the various components of the host system **250** and the communication devices **100**. The memory unit **292** can store functions used in implementing the IT policy as well as related data. Those skilled in the art know how to implement these various components. Other components can also be included as is well known to those skilled in the art. Further, in some implementations, the data store **284** can be part of any one of the servers.

In this exemplary embodiment, the communication device **100** communicates with the host system **250** through node

202 of the wireless network 200 and a shared network infrastructure 224 such as a service provider network or the public Internet. Access to the host system 250 can be provided through one or more routers (not shown), and computing devices of the host system 250 can operate from behind a firewall or proxy server 266. The proxy server 266 provides a secure node and a wireless internet gateway for the host system 250. The proxy server 266 intelligently routes data to the correct destination server within the host system 250.

In some implementations, the host system 250 can include a wireless VPN router (not shown) to facilitate data exchange between the host system 250 and the communication device 100. The wireless VPN router allows a VPN connection to be established directly through a specific wireless network to the communication device 100. The wireless VPN router can be used with the Internet Protocol (IP) Version 6 (IPV6) and IP-based wireless networks. This protocol can provide enough IP addresses so that each mobile device has a dedicated IP address, making it possible to push information to a mobile device at any time. An advantage of using a wireless VPN router is that it can be an off-the-shelf VPN component, and does not require a separate wireless gateway and separate wireless infrastructure. A VPN connection may be a Transmission Control Protocol (TCP)/IP or User Datagram Protocol (UDP)/IP connection for delivering the messages directly to the communication device 100 in this alternative implementation.

Messages intended for a user of the communication device 100 are initially received by a message server 268 of the host system 250. Such messages can originate from any number of sources. For instance, a message can have been sent by a sender from the computer 262*b* within the host system 250, from a different mobile device (not shown) connected to the wireless network 200 or a different wireless network, or from a different computing device, or other device capable of sending messages, via the shared network infrastructure 224, possibly through an application service provider (ASP) or Internet service provider (ISP), for example.

The message server 268 typically acts as the primary interface for the exchange of messages, particularly e-mail messages, within the organization and over the shared network infrastructure 224. Each user in the organization that has been set up to send and receive messages is typically associated with a user account managed by the message server 268. Some exemplary implementations of the message server 268 include a Microsoft Exchange™ server, a Lotus Domino™ server, a Novell Groupwise™ server, or another suitable mail server installed in a corporate environment. In some implementations, the host system 250 can comprise multiple message servers 268. The message server 268 can also be adapted to provide additional functions beyond message management, including the management of data associated with calendars and task lists, for example.

When messages are received by the message server 268, they are typically stored in a data store associated with the message server 268. In at least some embodiments, the data store can be a separate hardware unit, such as data store 284, with which the message server 268 communicates. Messages can be subsequently retrieved and delivered to users by accessing the message server 268. For instance, an e-mail client application operating on a user's computer 262*a* can request the e-mail messages associated with that user's account stored on the data store associated with the message server 268. These messages are then retrieved from the data store and stored locally on the computer 262*a*. The data store associated with the message server 268 can store copies of each message that is locally stored on the communication device 100. Alternatively, the data store associated with the message server 268 can store all of the messages for the user of the communication device 100 and only a smaller number of messages can be stored on the communication device 100 to conserve memory. For instance, the most recent messages (i.e. those received in the past two to three months for example) can be stored on the communication device 100.

When operating the communication device 100, the user may wish to have e-mail messages retrieved for delivery to the communication device 100. The message application 138 operating on the communication device 100 can also request messages associated with the user's account from the message server 268. The message application 138 can be configured (either by the user or by an administrator, possibly in accordance with an organization's IT policy) to make this request at the direction of the user, at some pre-defined time interval, or upon the occurrence of some pre-defined event. In some implementations, the communication device 100 is assigned its own e-mail address, and messages addressed specifically to the communication device 100 are automatically redirected to the communication device 100 as they are received by the message server 268.

The message management server 272 can be used to specifically provide support for the management of messages, such as e-mail messages, that are to be handled by mobile devices. Generally, while messages are still stored on the message server 268, the message management server 272 can be used to control when, if, and how messages are sent to the communication device 100. The message management server 272 also facilitates the handling of messages composed on the communication device 100, which are sent to the message server 268 for subsequent delivery.

For example, the message management server 272 can monitor the user's "mailbox" (e.g. the message store associated with the user's account on the message server 268) for new e-mail messages, and apply user-definable filters to new messages to determine if and how the messages are relayed to the user's communication device 100. The message management server 272 can also, through an encoder (not shown) associated therewith, compress message data, using any suitable compression/decompression technology (e.g. YK compression, JPEG, MPEG-x, H.26x, and other known techniques) and encrypt messages (e.g. using an encryption technique such as Data Encryption Standard (DES), Triple DES, or Advanced Encryption Standard (AES)), and push them to the communication device 100 via the shared network infrastructure 224 and the wireless network 200. The message management server 272 can also receive messages composed on the communication device 100 (e.g. encrypted using Triple DES), decrypt and decompress the composed messages, re-format the composed messages if desired so that they will appear to have originated from the user's computer 262*a*, and re-route the composed messages to the message server 268 for delivery.

Certain properties or restrictions associated with messages that are to be sent from and/or received by the communication device 100 can be defined (e.g. by an administrator in accordance with IT policy) and enforced by the message management server 272. These may include whether the communication device 100 can receive encrypted and/or signed messages, minimum encryption key sizes, whether outgoing messages must be encrypted and/or signed, and whether copies of all secure messages sent from the communication device 100 are to be sent to a pre-defined copy address, for example.

The message management server 272 can also be adapted to provide other control functions, such as only pushing cer-

tain message information or pre-defined portions (e.g. "blocks") of a message stored on the message server **268** to the communication device **100**. For example, in some cases, when a message is initially retrieved by the communication device **100** from the message server **268**, the message management server **272** can push only the first part of a message to the communication device **100**, with the part being of a pre-defined size (e.g. 2 KB). The user can then request that more of the message be delivered in similar-sized blocks by the message management server **272** to the communication device **100**, possibly up to a maximum pre-defined message size. Accordingly, the message management server **272** facilitates better control over the type of data and the amount of data that is communicated to the communication device **100**, and can help to minimize potential waste of bandwidth or other resources.

The mobile data server **274** encompasses any other server that stores information that is relevant to the corporation. The mobile data server **274** can include, but is not limited to, databases, online data document repositories, customer relationship management (CRM) systems, or enterprise resource planning (ERP) applications. The mobile data server **274** can also connect to the Internet or other public network, through HTTP server **275** or other suitable web server such as an File Transfer Protocol (FTP) server, to retrieve HTTP webpages and other data. Requests for webpages are typically routed through mobile data server **274** and then to HTTP server **275**, through suitable firewalls and other protective mechanisms. The web server then retrieves the webpage over the Internet, and returns it to mobile data server **274**. As described above in relation to message management server **272**, mobile data server **274** is typically provided, or associated, with an encoder **277** that permits retrieved data, such as retrieved webpages, to be decompressed and compressed, using any suitable compression technology (e.g. YK compression, JPEG, MPEG-x, H.26x and other known techniques), and encrypted (e.g. using an encryption technique such as DES, Triple DES, or AES), and then pushed to the communication device **100** via the shared network infrastructure **224** and the wireless network **200**. While encoder **277** is only shown for mobile data server **274**, it will be appreciated that each of message server **268**, message management server **272**, and HTTP servers **275** and **279** can also have an encoder associated therewith.

The contact server **276** can provide information for a list of contacts for the user in a similar fashion as the address book on the communication device **100**. Accordingly, for a given contact, the contact server **276** can include the name, phone number, work address and e-mail address of the contact, among other information. The contact server **276** can also provide a global address list that contains the contact information for all of the contacts associated with the host system **250**.

It will be understood by persons skilled in the art that the message management server **272**, the mobile data server **274**, the HTTP server **275**, the contact server **276**, the device manager module **278**, the data store **284** and the IT policy server **286** do not need to be implemented on separate physical servers within the host system **250**. For example, some or all of the functions associated with the message management server **272** can be integrated with the message server **268**, or some other server in the host system **250**. Alternatively, the host system **250** can comprise multiple message management servers **272**, particularly in variant implementations where a large number of mobile devices need to be supported.

The device manager module **278** provides an IT administrator with a graphical user interface with which the IT administrator interacts to configure various settings for the communication devices **100**. As mentioned, the IT administrator can use IT policy rules to define behaviors of certain applications on the communication device **100** that are permitted such as phone, web browser or Instant Messenger use. The IT policy rules can also be used to set specific values for configuration settings that an organization requires on the communication devices **100** such as auto signature text, WLAN/VoIP/VPN configuration, security requirements (e.g. encryption algorithms, password rules, etc.), specifying themes or applications that are allowed to run on the communication device **100**, and the like.

Rendering data files originally optimized or prepared for visualization on large-screen displays on a portable electronic device display often requires additional processing prior to visualization on the small-screen portable electronic device displays. According to an embodiment, this additional processing is accomplished by the rendering engine **125** shown in FIG. **1**. As will be appreciated by those of skill in the art, the rendering engine can be implemented in hardware, software, or a combination thereof, and can comprise a dedicated image processor and associated circuitry, or can be implemented within main processor **102**.

As noted above, the mobile device **100** may be a dual-mode or multiple-mode device that is configured to operate in not only voice-centric, but also data-centric networks. For example, the mobile device may be configured to communicate over a dual-mode network such as those identified above, including but not limited to CDMA, CDMA2000, GSM/GPRS, EDGE, EVDO, HSPA, HSPA+, UMTS, and LTE, and may also be configured to communicate over wireless networks that are typically IP-based, such as wireless LANs implementing the Wi-Fi protocol (one or more of the IEEE 802.11 suite of protocols), personal area networks implementing other protocols such as Bluetooth, other wireless networks implementing wireless broadband standards such as WiMAX (one or more of the IEEE 802.16 suite of protocols), and the like. The mobile device may also be configured to operate over a fixed connection to an IP-based network, for example via a USB or Ethernet connection. For ease of reference, these two modes are respectively referred to generally as cellular and LAN modes or networks, where LAN includes both wireless and wired LANs. Although the description herein is generally directed to an implementation on a mobile communication device typically communicating over networks over a wireless link, it will be understood by those skilled in the art that the description is not intended to be so limiting, and includes wired connections. The mobile device **100** may therefore be equipped with multiple interfaces and transceivers for communicating over different fixed and wireless networks, and may be configured to communicate over more than one network at a given time.

Further, the mobile device **100** may capable of operating in a single-line mode and in a multi-line mode. Thus, inbound calls to a plurality of telephone numbers associated with the device **100** may be received at the device **100** when in multi-line mode; and when the device **100** is in the multi-line mode, outbound calls may be placed at the device **100** using a selected one of the telephone numbers associated with the device, so that caller identification delivered to the recipient of the outbound call will identify the call as being placed using that selected telephone number.

Some inbound and outbound calls may be handled through a private branch exchange (PBX) in the same enterprise network environment as the mobile device **100**, for example a PBX associated with the host system **250**. If the mobile device is configured to communicate with the host system **250** over

at least a LAN, the PBX may be configured to connect calls from the mobile device **100** and route calls directed to the device **100** over the LAN. Calls may also be routed through a remotely hosted PBX service assigned to the enterprise, but not necessarily forming a physical part of the enterprise's network. The enterprise's systems may be distributed over significant geographic distances. Hosted telephony services may be used to provide an integrated PBX environment for all users within the enterprise.

FIG. **5** illustrates a possible network topology for the mobile device **100**, including two possible paths for data traffic **510** and voice traffic **560**. The enterprise environment of the host system **250** may include a PBX **580**, provided with connectivity to the public switched telephone network (represented in FIG. **5** by the telephone network cloud **570**) over a PRI (primary rate interface) connection. The PBX **580** may be a conventional legacy PBX (i.e., a TDM or time division multiplexing PBX) or an IP PBX based on an IP architecture, or combination thereof. As noted above, the PBX may be a remotely hosted service. Voice communication between the mobile device **100** and the PBX **580** may therefore be routed through the wireless network **200**, through the public switched telephone network **570** and wide area network **224**, and thence to the PBX **580**, and vice versa. Each mobile device **100** to be connected with the PBX **580**, as well as any conventional office telephones **590** connected to the PBX **580**, may be assigned a DID (direct inward dial) or extension number. In addition, as described previously the mobile device **100** may also communicate via the wireless network **200** and over a wide area network **224** with the host system **250** over a data communication channel, which may be an IP-based channel.

The host system **250** in this embodiment comprises or is associated with the PBX **580** through a server or gateway **550**. The server **550** and the PBX **580** may communicate over an IP data channel, for example implementing a SIP (session initiation protocol) circuit. If the PBX **580** is a TDM PBX, then the communication channel may be an ISDN PRI connection, and the server **550** may convert TDM data received from the PBX **580** to IP data. After receiving voice call data from the PBX **580**, the server **550** provides the data in a VoIP-compliant format to other components of the host system **250** for re-routing to the mobile device **100** over the data communication channel **510**. Thus, calls to or from the mobile device **100** may be routed over an IP network to the PBX **580**, allowing the host system **250** to handle authentication of the mobile device **100** and other administrative functions relating to the voice call.

The mobile device **100**'s access to IP networks and to the public switched telephone network is provided through the wireless network **200**, which as described above may comprise one or more nodes **202** configured for communication in accordance a suitable mobile telephony standard. In turn, the wireless network **200** provides the mobile device **100** with connectivity to the Internet or other public wide area network **224**, and thence to the host system **250**. At the same time, if the mobile device **100** is a multiple-mode device, it may also communicate with the host system **250** over an enterprise LAN, represented by the access point **520**. The mobile device **100** may therefore be able to handle calls routed through the PBX **580** not only over the wireless network **200**, but also through the LAN **520**. This network configuration thus provides the user with a communication service handling both fixed and wireless voice calls. It will also be appreciated by those skilled in the art that access to the host system **250** need not be limited to access via the enterprise LAN network (whether wireless or not). Instead, the mobile device **100** may access the host system **250** over a network, such as the wide area IP network **224**, via an access point **530**, which may be located at the mobile device user's home, or at a public or private Wi-Fi hotspot.

For some wireless networks **200** or LANs **520**, the mobile device **100** may be registered or activated with the respective network. A process for identifying a subscriber to a cellular network using a SIM card **126** is described above. Other methods of registering or identifying the mobile device **100** to various networks will be known to those of ordinary skill in the art. However, registration or activation may not be required for all wireless networks **200**, LANs **520** or other access units **530**, as some networks may allow access without prior registration or activation. The mobile device **100** may also be provisioned or configured to access the wireless network **200** or LAN **520** or other access point **530**. Methods of provisioning services on a mobile device **100** will be generally known to those skilled in the art, but as a non-limiting example, a request for registration may be sent from the mobile device **100** to a registration server of a service (not shown). If the request is approved, the registration server may transmit to the mobile device **100** a service book containing data and instructions to enable the mobile device **100** to provision the service. The service book, when received at the mobile device **100**, may be self-executing, and permits the user to enter account information relevant to the associated service. This information is then transmitted from the mobile device **100** to a provisioning server of the service provider (not shown), which may then create a service account associated with the mobile device **100**. Provisioning may also be carried out in compliance with the OMA DM (Open Mobile Alliance Device Management) specification version 1.2 or its predecessor or successor versions, published by the Open Mobile Alliance Ltd.

In addition to the provisioning with the service book, additional settings may be established at the device **100** or pushed to the device **100** concerning its access to the wireless network **200**, LAN **520**, or access point **530**. For example, configuration settings may be established disabling one or more modes of communication. If the configuration settings are set to disable cellular communications, the mobile device **100** may be restricted to communication over the LAN **520** only. Such a setting may be desirable in an enterprise environment where security or accounting concerns require that calls be routed through the host system **250** for its authentication and record-keeping functions, or where it is desirable to control costs by disabling cellular communication. The mobile device **100** may be restricted to permit communication over the access point **530** as well in this instance. These additional settings may be stored in a branding or configuration file stored in the memory of the mobile device **100**. When the mobile device **100** is initialized, the settings, which may have been established during the provisioning described above, are checked to determine whether the mobile device **100** is permitted to communicate using each provisioned service.

When the mobile device **100** is configured to handle both fixed and mobile voice communications as described above, the device **100** may consequently be converted from a single-line device—a device associated with a single telephone number—to a multiple-line device. The mobile device **100** may be registered with a cellular network service, but at the same time it may be associated with a DID through the PBX **580**. Therefore, the device **100** will be reachable through two distinct telephone numbers, and each telephone number will be routed to a different path. In other embodiments, it may be possible to provision the device **100** with more than two telephone numbers.

Accordingly, the mobile device **100** may be configured with a user interface providing the user of the mobile device **100** with access to all lines. Referring to FIG. **6**A, a first example of a graphical user interface **600***a* is shown displayed in the display **110** of a mobile device **100** configured for multiple-line and dual-mode service. The graphical user interface **600***a* may comprise a banner display, typically positioned across the top of the display **110**. This banner display may be used to display current time and date information. In addition, the banner display may feature information about the currently joined network and signal strength **610**. In the example of FIG. **6**A, the currently joined network is indicated to be an EDGE network.

The particular graphical user interface **600** shown in FIG. **6**A is an options screen for managing the connections of the mobile device **100**. The graphical user interface **600***a* features options for turning on or off individual network connections, here indicated as "Mobile Network" **620**, representing the cellular network; "Bluetooth" **622**; and "Wi-Fi" **624**. In this example, both the mobile and Wi-Fi networks **620**, **624** are indicated as being on. The graphical user interface **600***a* also provides menu items to select further options screens for the mobile network **626**, Bluetooth **628**, and Wi-Fi **630**.

Turning to FIG. **6**B, a further graphical user interface **600***b* is shown, displaying the status of services available at the mobile device **100**. The graphical user interface **600***b* lists "Integrated Mobile Voice" **640**, representing the fixed mobile convergence feature of receiving and placing calls via the PBX **580** from the mobile device **100**, as being "available" and connected through the "Mobile Network", meaning that this voice service is provided via the data communication path **510**, through the wireless network **200** shown in FIG. **5**. Similarly, the "Mobile" (i.e., cellular) service **641** and the "Enterprise Server" service **644** are indicated as being connected through the "Mobile Network" as well. In this example, however, "Internet Service" **642** is indicated as being connected through the "Wi-Fi Network". This setting may have been established using a configuration setting or in response to an express user instruction to use the Wi-Fi network **520** for Internet service. The graphical user interface **600***b* also shows current status information regarding the mobile network type **646** and provider **648**, and some detail concerning the LAN (in this example, the Wi-Fi network) **650**.

FIG. **6**C illustrates a further possible graphical user interface **600***c* displaying mobile network options for the device **100**. In this graphical user interface **600***c*, the current mobile network is identified at **660**, together with a user interface element to select an alternate mobile network if desired. The graphical user interface **600***c* also includes options for the network selection mode **662**, allowing for a selection between "automatic" and "manual", wherein in the "automatic" mode, the device **100** attempts to automatically discover and join any suitable network in range. Finally, FIG. **6**D illustrates a graphical user interface **600***d* in a phone application executing on the device **100**. This graphical user interface **600***d* provides the user with the option of selecting one of two telephone numbers **670**, **680** prior to placing a call from the mobile device **100**.

However, the configuration of the graphical user interface **600***a* through **600***d* is generally selected at the time of the original provisioning of the fixed and mobile voice service on the device, or alternatively when the mobile device **100** is originally provisioned. Yet, network conditions at the mobile device **100** may vary, at least for the reason that the user of the mobile device **100** may on occasion leave the coverage area of one or more of the networks. Thus, while the mobile device **100** may have been originally provisioned as a dual-mode device, it may subsequently lose connectivity to either the LAN **520**, access point **530**, or the wireless network **200**. Or, the mobile device **100** may have been originally provisioned with both cellular and LAN connectivity, but enterprise policy may have changed to forbid use of the mobile device **100** for calls routed outside the host system **250**, or the SIM card may have been removed from the mobile device **100**. If a loss of connectivity to the wireless network **200** occurs, or if removal of the SIM card or a new configuration setting prevents use of the wireless network, the telephone number associated with the cellular service will be invalid; calls can neither be made from, for received at, that number. However, the graphical user interface will not have changed, and the invalid number will still be displayed to the user in the graphical user interface **600***d*.

Accordingly, a method is provided for reconfiguring the user interface of the mobile device **100** each time an integrated fixed and mobile voice communication system is initiated at the mobile device **100**. Referring to FIG. **8**, at **800** the system is initialized. At **805**, a determination is made whether the SIM or RUIM card **126** is present in the mobile device **100**. If it is not present, then control passes to **810**, where it is determined whether the mobile device **100** is an activated CDMA device. This may be determined by a review of the configuration settings stored at the device **100**. If the device **100** is not an activated CDMA device, then it is determined at **815** whether the device **100** is provided with a LAN connectivity module such as a Wi-Fi transceiver or a wired connection to a LAN.

If the device is so provided, then at **820** the user interface is adapted for one-line mode, as shown in FIGS. **7**A to **7**D. FIG. **7**A illustrates a graphical user interface **700***a* similar to the graphical user interface **600***a* of FIG. **6**A. However, in this embodiment, certain entries are removed from the user interface, as they relate to cellular wireless service, which is not available. Thus, the graphical user interface **700***a* lists only Bluetooth **622** and Wi-Fi **625** as available network connections, and provides menu options **628**, **630** for these connections only. In addition, the network connectivity information **710** displayed in the banner of the graphical user interface **700***a* indicates that the current service is Wi-Fi. In FIG. **7**B, the services status lists "Integrated Mobile Voice" **740** as being available over a Wi-Fi network, rather than over a wireless (cellular) network. The other services, "Internet Service" **642** and "Enterprise Server" **744**, are listed as being available over the Wi-Fi network only. In this example, the status of the "Mobile" service **641** shown in FIG. **6**B is not indicated at all in the graphical user interface **700***b*, as cellular service is not currently available in this example. In another embodiment, the graphical user interface **700***b* may indicate that the "Mobile" service is "unavailable". Thus, the current status information in FIG. **7**B reflects the only available network, the Wi-Fi network **650**. In FIG. **7**C, the mobile network options shown in the graphical user interface **700***c* are limited only to the selection mode option **662**, since the unavailability of cellular service to the mobile device **100** renders the option to choose a network provider moot.

Finally, FIG. **7**D illustrates the adapted graphical user interface **700***d* in the phone application for placing a call. The telephone number relating to the cellular network service, since it is now invalid, is removed from the user interface, leaving the user with sole option of selecting the remaining DID number **780**.

Thus, following the branch of the process of FIG. **8** described above results in an adaptation of the user interface to reflect the connectivity available to the mobile device **100**.

Also following FIG. **8**, the device **100** may in some circumstances remain configured with its original graphical user interface. Returning to **805**, if it is determined that there is a SIM or RUIM **126** present in the mobile device **100**, then it is determined at **825** whether LAN connectivity (in this example, Wi-Fi, although the system may instead determine whether there is LAN connectivity through a different wireless connection or a fixed connection) is provided on board the device **100**. If it is not, then the mobile device **100** user interface is adapted to reflect that only the cellular service and the cellular telephone number is available to be used at **835**. In some embodiments, the mobile device **100** may still be configured for a two-line mode, since the PBX **580** may be configured to provide connections for both lines to the mobile device **100** over the cellular network. If a LAN connection (e.g., Wi-Fi) is available, then at **830** the mobile device **100**'s user interface may be adapted to reflect that there remain at least two possible lines to the mobile device **100**, so the user interface need not be adapted. Similarly, if at **805** it is determined that there is no SIM/RUIM **126** present, but at **810** it is determined that the mobile device **100** is an activated CDMA device (which does not require a SIM card), at **825** it is then determined whether the device **100** is equipped with LAN connectivity. If it is not, then again the mobile device **100**'s user interface is adapted to reflect that only cellular service is available. If LAN connectivity is available, then the user interface may be adapted to reflect that there remain at least two possible lines to the mobile device **10**. Thus, if cellular service is not available to the mobile device **100**, then the mobile device **100**'s user interface may be adapted so that it appears that the device **100** is a single-line device; but conversely, if cellular service is available to the mobile device **100**, in this embodiment the device **100** will be configured for cellular service regardless of the presence or absence of Wi-Fi at the mobile device **100**.

When the user interface is adjusted as described above, further interface elements may be adapted as well. As shown in FIG. **9**A, some icons **910**, **930** displayed in the "ribbon" or the home screen **900***a* of the mobile device **100** may represent service entry points for services that require a cellular network connection; another icon **920** may represent another telephony service that is implemented through a LAN connection. Those icons representing services requiring the cellular network connection may be removed as a result of the user interface adjustment described above, as shown in the user interface **900***b* of FIG. **9**B, which illustrates that of icons **910**, **920** and **930**, only the icon **920**, relating to the service implemented through the LAN connection, remains.

In the foregoing example, the determination of the mobile device **100**'s availability for CDMA may be determined from the current IT settings or provisioning of the mobile device **100**. Further, in the method illustrated in FIG. **8**, the determination whether the mobile device **100** user interface was to be adapted for single-line mode was premised not only on the current IT settings or provisioning of the mobile device, but also on whether the device **100** was provided with a SIM/RUIM **126**. However, the user of the mobile device **100** may provide their own SIM/RUIM **126**, although use of the phone on the cellular network may be prohibited by the enterprise's internal policies. Therefore, as shown in FIG. **10** in a further embodiment, after initialization **1000** of the integrated fixed and mobile voice communication feature on the mobile device **100**, any relevant IT policy at the device is reviewed at **1005**. If, as a result of the IT policy, it is determined at **1010** that cellular service is to be inactivated, then at **1015** the user interface of the mobile device **100** is adapted to provide options for a single line, the DID line available through the LAN, only. If it is determined that cellular service is not to be inactivated, then at **1020** the user interface is adapted for two-line communication.

In a further embodiment, referring to FIG. **11**, the mobile device **100** may have been provisioned for Wi-Fi or LAN connectivity only at **1100**, and cellular network connectivity may have been disabled. This configuration may have been fixed at the time the mobile device **100** was deployed in the enterprise network. In this embodiment, the mobile device **100** will enjoy LAN connectivity to the host system **250** only so long as it is within the coverage area of the enterprise's LAN **520** (and similarly, if the device is provisioned or configured for access to the home system **250** via the access point **530**, it will enjoy connectivity to the host system **250** provided it is in the coverage area of the access point **530**). However if the user moves out of range or there is otherwise a loss of connectivity detected **1105**, at **1110** the user interface automatically deactivates the menu options associated with the device **100**. In this embodiment, the user interface items may be merely greyed out, or may be removed altogether, similar to FIGS. **7**A through **7**D. When the mobile device **100** regains the LAN signal at **1115**, it may reconnect with the host system **250** and advise of its return to the network, and then reinitialize its integrated fixed and mobile voice communication system and attempt to re-provision itself, downloading any new IT policies or other settings, at **1120**.

In still a further embodiment, the mobile device **100** may have been provisioned for dual-mode communications as shown at **1200** of FIG. **12**, but may have been lacking the SIM or other registration information to be able to communicate over the cellular network. Accordingly, a first user interface displayed by the mobile device **100** may not include an option to select calling functions using the cellular network. As a next step, any SIM/RUIM in the device **100** is detected at **1205**. Next, it is determined at **1210** whether the device is provisioned with cellular functionality as well. If it is, then the user interface is adapted by the mobile device **100** for a multi-line telephone mode including cellular communications at **1215**; if the device **100** is not so provisioned, then the first user interface is retained at **1220**. In a further embodiment, the mobile device **100** may be configured to receive a second SIM card in addition to the first, so if the new SIM card is detected at **1215** and the mobile device **100** is provisioned for cellular communication, at **1215** the user interface may be adapted for multi-line telephone mode including communication over the cellular network using the additional SIM card.

Finally, with respect to FIG. **13**, after the mobile device **100** has been provisioned for both cellular and LAN communication at **1300**, a loss of cellular connectivity may be detected at **1305**. At **1310**, the mobile device **100** may adapt the user interface to display only Wi-Fi or LAN-related options as described above. In addition, at **1315**, the device **100** alters its default codec settings stored in its memory. It will be appreciated by those skilled in the art that when a connection is made between the mobile device **100** and another device in the enterprise network, the device **100** and the other device negotiate the selection of the voice codec to be used for the particular network type and quality of the connection. The mobile device **100** may store a list of available codecs with which it can negotiate. However, the set of suitable codecs for use over the cellular network may be different from those that are suitable for use with another network, such as a Wi-Fi network. Therefore, in this embodiment, a first set of codecs may be identified in a first profile setting for use with a first cellular network; however, once it is detected that cellular connectivity has been lost, it is presumed that future voice

communication will be routed through the LAN, so at **1315** the mobile device **100** may retrieve a further set of codecs identified in a second profile setting for use with the LAN. This further set of codecs may then be used to negotiate a new voice connection with the other device.

The systems and methods disclosed herein are presented only by way of example and are not meant to limit the scope of the subject matter described herein. Other variations of the systems and methods described above will be apparent to those in the art and as such are considered to be within the scope of the subject matter described herein. For example, it should be understood that steps and the order of the steps in the processing described herein may be altered, modified and/or augmented and still achieve the desired outcome.

The systems' and methods' data may be stored in one or more data stores. The data stores can be of many different types of storage devices and programming constructs, such as RAM, ROM, flash memory, programming data structures, programming variables, etc. It is noted that data structures describe formats for use in organizing and storing data in databases, programs, memory, or other computer-readable media for use by a computer program.

Code adapted to provide the systems and methods described above may be provided on many different types of computer-readable media including computer storage mechanisms (e.g., CD-ROM, diskette, RAM, flash memory, computer's hard drive, etc.) that contain instructions for use in execution by a processor to perform the methods' operations and implement the systems described herein.

The computer components, software modules, functions and data structures described herein may be connected directly or indirectly to each other in order to allow the flow of data needed for their operations. It is also noted that a module or processor includes but is not limited to a unit of code that performs a software operation, and can be implemented for example as a subroutine unit of code, or as a software function unit of code, or as an object as in an object-oriented paradigm), or as an applet, or in a computer script language, or as another type of computer code.

A portion of the disclosure of this patent document contains material which is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by any one of the patent document or patent disclosure, as it appears in the Patent and Trademark Office patent file or records, but otherwise reserves all copyrights whatsoever.

We claim:

1. In a mobile device, the method of:

determining whether the mobile device is configured for communication over a cellular network connection, the mobile device being configurable for communication over at least one cellular network and over at least one wireless LAN, the mobile device being configured for voice communication using at least one mobile telecommunications standard and at least one IP-based network;

determining whether the mobile device is configured for communication over a wireless LAN connection; and

configuring a user interface to reflect current voice communication availability with a cellular telephone number associated with the mobile device when the mobile device is determined to be configured for communication over the cellular network connection; and

configuring the user interface to reflect current voice communication availability with a direct inward dial number at a PBX associated with the mobile device when:

the mobile device is determined to be configured for communication over the wireless LAN connection, or

the mobile device is determined to be configured for communication over the cellular network connection and connectivity is available over the cellular network connection with the PBX,

the configuring of the user interface including displaying icons selectable to invoke corresponding service entry points for those telephony services for which the mobile device is currently configured and for which connectivity is available.

2. The method of claim **1**, wherein determining whether the mobile device is configured for communication over the cellular network connection comprises at least one of:

determining whether a SIM or RUIM card is present in the mobile device; and

determining whether the mobile device is an activated CDMA device.

3. The method of claim **1**, wherein determining whether the mobile device is configured for communication over the wireless LAN connection comprises determining whether the mobile device comprises a communications subsystem configured for communicating over the wireless LAN connection.

4. The method of claim **1**, wherein determining whether the mobile device is configured for communication over the cellular network connection comprises determining whether connectivity over the cellular network has been inactivated by a policy setting at the mobile device.

5. The method of claim **1**, wherein the configuring of the user interface includes removing icons selectable to invoke corresponding service entry points for telephony services for which the mobile device is not currently configured or for which connectivity is currently not available.

6. The method of claim **1**, wherein the configuring of the user interface further comprises displaying a mobile device telephone number only for those telephony services for which the mobile device is currently configured and for which connectivity is available.

7. The method of claim **1**, wherein the mobile device is initially configured for communication over the cellular network connection and the wireless LAN connection, and further wherein the user interface is initially configured to reflect voice communication availability over both the cellular network connection and the wireless LAN connection, the method further comprising:

detecting a loss of cellular network connectivity at the mobile device; and

configuring the user interface to reflect voice communication availability only over the wireless LAN connection.

8. The method of claim **7**, wherein the mobile device is configured to use at least one selected set of codecs for voice communication over the cellular network connection, the method further comprising selecting a second set of codecs for voice communication over the wireless LAN connection upon detecting the loss of cellular network connectivity.

9. A computer program product comprising a non-transitory medium storing code which, when executed, causes a communication device to carry out the method of claim **1**.

10. A mobile device, including:

at least one communications subsystem;

a memory;

a processor in communication with the at least one communications subsystem and the memory, the processor being configured to:

determine whether the mobile device is configured for communication over a cellular network connection;

determine whether the mobile device is configured for communication over a wireless LAN connection;

configure a user interface to reflect current voice communication availability with a cellular telephone number associated with the mobile device when the mobile device is determined to be configured for communication over the cellular network connection; and

configure the user interface to reflect current voice communication availability with a direct inward dial number at a PBX associated with the mobile device when:

the mobile device is determined to be configured for communication over the wireless LAN connection, or

the mobile device is determined to be configured for communication over the cellular network connection and connectivity is available over the cellular network connection with the PBX,

the configuring of the user interface including displaying icons selectable to invoke corresponding service entry points for those telephony services for which the mobile device is currently configured and for which connectivity is available.

11. The mobile device of claim **10**, wherein the mobile device is configured for voice communication over the cellular network connection using at least one mobile telecommunications standard and at least one IP-based network.

12. The mobile device of claim **10**, wherein the processor is configured to determine whether the mobile device is configured for communication over the cellular network connection by determining at least one of:

whether a SIM or RUIM card is present in the mobile device; and

whether the mobile device is an activated CDMA device.

13. The mobile device of claim **10**, wherein the processor is adapted to determine whether the mobile device is configured for communication over the cellular network connection comprises determining whether connectivity over the cellular network has been inactivated by a policy setting stored in the memory.

14. The mobile device of claim **10**, wherein the configuring of the user interface includes removing icons selectable to invoke corresponding service entry points for telephony services for which the mobile device is not currently configured or for which connectivity is currently not available.

15. The mobile device of claim **10**, wherein the configuring of the user interface further comprises displaying a mobile device telephone number only for those telephony services for which the mobile device is currently configured and for which connectivity is available.

16. The mobile device of claim **10**, wherein the mobile device is initially configured for communication over the cellular network connection and the wireless LAN connection, and further wherein the user interface is initially configured to reflect voice communication availability over both the cellular network connection and the wireless LAN connection, wherein the processor is further configured to:

detect a loss of cellular network connectivity at the mobile device; and

configure the user interface to reflect voice communication availability only over the wireless LAN connection.

17. The mobile device of claim **16**, wherein the mobile device is configured to use at least one selected set of codecs for voice communication over the cellular network connection, and the processor is further configured to select a second set of codecs for voice communication over the wireless LAN connection upon detecting the loss of cellular network connectivity.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,509,186 B2
APPLICATION NO. : 12/843525
DATED : August 13, 2013
INVENTOR(S) : Kevin John Oerton and Brian Alexander Oliver

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Specification

Column 2, line 55, delete "mobib" and insert therefor --mobile--;

Column 3, line 27, delete "encryptioridecryption" and insert therefor --encryption/decryption--;

Column 5, line 15, delete "storod" and insert therefor --stored--;

Column 6, line 27, delete "auxiliary 110" and insert therefor --auxiliary I/O--;

Column 7, line 39, delete "AID" and insert therefor --A/D--;

Column 8, line 12, delete "abase" and insert therefor --a base--;

Column 9, lines 56-57, delete "DI-ICP" and insert therefor --DHCP--;

In the Claims

Column 21, line 57, after "LAN connection;", delete "and"; and

Column 23, lines 31-33, delete "wherein the processor is adapted to determine" and insert therefor --wherein determining--.

Signed and Sealed this
Twenty-fourth Day of September, 2013

Teresa Stanek Rea

Teresa Stanek Rea
Deputy Director of the United States Patent and Trademark Office